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MOTION PICTURES IN THE CLASSROOM

AN EXPERIMENT TO MEASURE THE VALUE OF MOTION PICTURES AS SUPPLEMENTARY AIDS IN REGULAR CLASSROOM INSTRUCTION

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The Superintendents and Assistant Superintendents of schools, by their generosity in agreeing to a special course of study for the pupils involved, by the care they took in the selection of teachers, and by the interest they displayed in the investigation did much toward making the results of the experiment in the various cities comparable with each other.

The Directors of Visual Education in the several cities gave time and thought to the experiment, made many valuable suggestions, and were most efficient in supervising and inspecting the work.

The Experimental Teachers were faithful and courageous in carrying out the work from beginning to end with an unfamiliar medium of instruction.

The Control Teachers cannot be praised too highly for the fine professional spirit they showed and the fidelity with which they followed instructions, forgetting for a time their own ideas and practices.

The Research Bureau of Columbia College, the Statistical Staff of the School of Education, University of Chicago, and the Educational Records Bureau of New York City deserve our thanks for the efficient way in which they discharged the laborious task of recording and analyzing the extensive data derived from the experiment.

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INTRODUCTION

The history of this experiment begins with the action of the National Education Association, in 1922, in appointing a Committee on Visual Education. A similar committee was named each year until 1927. These committees consisted of leading teachers and students of education. Doctor Charles H. Judd, Director of the School of Education of the University of Chicago, was selected as Chairman of the first committee. Doctor Thomas E. Finegan, of Harrisburg, Pennsylvania, and Doctor Frank Cody, of Detroit, Michigan, each served as chairman of this committee. Upon its organization, the committee instituted an inquiry to ascertain what material in visual aids, adapted in general to instructional purposes, was available for classroom use.

The committee gave especial consideration to the use of motion pictures as visual aids for teaching purposes. It reported to the Annual Meeting of the National Education Association, in 1923, that in order to get reliable information on the method of procedure in making motion pictures, on the cost of production, and other essential knowledge, the committee had held conferences with the officials of the Motion Picture Producers and Distributors of America, Inc., and that this organization had manifested a cordial desire to render any assistance possible by coöperating with the National Education Association in the solution of the problems involved in the production of classroom films.

The interest of the National Education Association in the use of motion pictures in classroom work was brought to the attention of Eastman Kodak Company, which is a member of the Motion Picture Producers and Distributors of Amer-

ica, Inc. Members of the National Education Association Committee also conferred with representatives of the Eastman Company. In these conferences the representatives of this company expressed willingness to coöperate with the National Education Association Committee, but stated that definite action could not be contemplated until more exact and comprehensive data on the existing supply of teaching films, and on the existing or probable demand for such films, had been collected and studied.

In February, 1926, Mr. George Eastman announced that during the preceding three years his company had conducted a survey of the whole field of teaching films. The survey showed in substance the following:

1. That few pictures adapted to classroom use had been produced.
2. That the cost of equipment and films had made the use of films as regular classroom instrumentalities prohibitive.
3. That large capital investment would be required to produce films on a scale adequate to school needs.
4. That adequate experiments had not been made in the practical use of films in classroom work to establish their value as aids to teaching.
5. That school authorities would not be justified in making the expenditures required for film service until adequate experiments were made and the value of films as teaching aids definitely determined.

Developments of recent years have resulted in the production of a standard narrow-width 16 mm. film which provides pictures of adequate size for all classroom purposes, and at a greatly reduced cost. The use of this new standard narrow-width film, which is made on safety stock, has the

added advantage of eliminating fire hazards, and has the approval of the National Board of Fire Underwriters. Portable projectors have been developed which are simple in construction and easily operated. These projectors may be taken from room to room or from building to building and used freely, since no booth is required for their operation. The cost of projectors, therefore, has been greatly reduced.

Mr. Eastman also announced that the Eastman Kodak Company had decided to undertake a practical experiment in the use of films in the schools to study the following questions:

1. Can films be produced which are correlated with standard courses of study?
2. Can the teaching value of these films, when used to supplement the usual pedagogical devices of the teacher in the classroom, be measured?
3. Is the educational value of the contributions of the films sufficient to justify the expenditure required to make them a regular part of the equipment of the schools?

Realizing the difficulty and complexity of the problems that would be involved in such an experiment, it was announced that a period of two years would be taken for its completion; that all expenses involved in conducting the experiment, including the production of films, the use of projectors, screens, and other apparatus, would be paid by the company; and that the company would neither rent nor sell films or apparatus during the period of the experiment.

The Report of the Committee on Visual Instruction to the National Education Association, at its Annual Meeting in 1926, included a complete statement of the plan of the proposed experiment and recommended that the teachers and

school authorities of the country should cordially coöperate in the undertaking. The report of the committee was unanimously adopted by the National Education Association.

When the authors of this report were requested to assume direction of the enterprise, they were assured a free hand in formulating the plans to conduct a thorough and impartial investigation in order to determine the value of films as supplementary aids in classroom instruction. They were also told that so much was involved of interest to the schools, to the public, and to the company, that the plans developed and the tests conducted should be rigorous and impartial. The authors were advised that the company desired such professional and scientific plans and methods pursued throughout the entire course of the experiment as the recognized standards prevailing in such work and tests required. The authors were requested to report specifically upon these questions:

1. Are the motion-picture films which have been produced for this experiment adapted to classroom instruction?
2. Do these films have a measurable value in supplementing class instruction?
3. What are the values and influences of these films as nearly as you are able to determine?
4. What are the objections, if any, to the use of films for teaching purposes?
5. Does the value of the films in supplementing instruction outweigh objections sufficiently to justify their use in classroom work?

The authors desire to state in this introduction that the attitude assumed by the sponsors of the experiment was entirely disinterested, and that whole-hearted coöperation was

extended us in our effort to make the experiment contribute impartial and strictly scientific data upon which to base an honest determination of the basic questions involved.

Ben D. Wood
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MOTION PICTURES IN THE CLASSROOM

CHAPTER I

DESCRIPTION OF THE EXPERIMENT

Number of students and teachers involved — Coöperating cities — Areas of learning — Study Guides — The Tests — Directions to teachers — Experimental Teachers' Guides — Character of films — Films on sixteen millimeter safety stock — Distinguishing characteristics of the experiment — Time schedule — Summary.

PURPOSE

The purpose of this experiment was to learn what contributions twenty teaching films might make when used as a regular and integral part of classroom work. The films have been viewed as an addition to the present pedagogical devices of the schools, and not as a substitute for present instrumentalities, nor as a means to revolutionize the aims of education. The main emphasis throughout has been on ascertaining the nature and extent of the influence of the films on the attainment of the accepted goals of sound classroom practice, as these have usually been measured and observed. We have been equally ready and alert to detect and measure any losses which might occur as a result of giving classroom time to the viewing of films.

It has long been held that motion pictures do make some definite and unique contributions to education, which under normal school conditions cannot be given so effectively in the classroom by any other means, such, for example, as

precise ideas of dynamic relations, motion studies, and in general a sense of the "concrete" existence of places and objects which otherwise remain for most children largely verbalisms or images of flat and lifeless still pictures. No one has seriously questioned the value of such contributions, but the question has sometimes been raised whether this enhancement of the child's concrete experience serves the broader purposes of his education; that is, whether the emphasis on concrete experience which is provided by motion pictures is not greater than is justifiable on the ground that it holds his attention too long on material objects and their characteristics and diverts it from the more abstract processes of thinking.

On the other hand, it may seem reasonable to surmise that, in addition to the unique and characteristic contributions mentioned above, classroom films may also increase the rate and improve the quality and longevity of learning; arouse stronger and more fertile interests; stimulate more extensive, more appropriate, and more satisfying use of books and libraries; increase the quantity, quality, and meaningfulness of projects undertaken on the student's own initiative; improve the vocabulary and composition of children, and in general improve his thinking habits by giving him larger opportunities to start his thinking with a greater wealth of concrete experiences than can be gained by any other means now available to the schools.

Both scientists and school administrators, however, are skeptical of the most plausible questions and surmises, and are rightly maintaining an open mind on the values and expediency of adopting and using films in the classroom on a large scale and in a comprehensive way. Their attitude is that, granting both the value and the certainty of certain unique contributions, general adoption of classroom films cannot be recommended to school boards until it has been

shown that the use of teaching films not only entails no loss in reaching the ordinary goals of education, but actually promotes their attainment to a significant degree, and that films can be made an integral and administratively feasible part of the regular school program, working with and enhancing the effectiveness of the customary pedagogical devices and procedures.

Whatever may be the justice of these two opposing points of view, they suggest the wisdom of designing the tests which are to measure the comparative achievement of the children who are taught with and without the films in such a way that they will measure both types of outcome. They should measure the clearness and completeness of the child's ideas concerning the objects with which instruction deals and they should, at the same time, measure his ability to generalize and think about them. They should, in other words, measure both the direct and the indirect outcomes of instruction.

Various types of tests were used in this investigation and were designed not only to give more reliable and valid findings than would be furnished by a single type of test, but also to secure data upon both the direct and the indirect outcomes. For these reasons also, the investigation was concerned with observations on the interest and self-activity of students in the classroom; with the number and character of the projects undertaken and completed by the students; with the amount of reading done by the students as manifested by their recitations in the classroom, their written projects, and by their use of the school library; and with the observations and reports of the teachers and school officers who were in daily and immediate contact with the classes that participated in the experiment.

PLAN OF THE EXPERIMENT

In studying the merits of a new pedagogical device the essential problem is to compare the progress of large numbers of classes that have had its benefit in a fairly large but well-defined area of instruction for a considerable period of time, with the progress of similar classes that have devoted the same amount of time, under the same conditions, to the same area of instruction, without the aid of the device in question. The validity of such a comparison depends, among other things, upon the extent to which equality and normality of teaching and learning ability and conditions in the two groups of classes compared have been achieved, or upon the extent to which differences can be measured and fair allowance made for them; upon the reliability and validity of the measurements and observations used; and upon the extent to which chance factors of all sorts have been eliminated or accounted for.

Number of students and teachers involved. Nearly 11,000 children in more than three hundred Geography and General Science classes, taught by nearly two hundred teachers, in grades four to nine, inclusive, and distributed in twelve cities, participated in this experiment. Of the 11,000 children there were approximately 7500 in the Geography classes and 3500 in General Science classes. The Geography and General Science students were about equally divided between the experimental and control groups. The experimental classes were those which had the benefit of the films and the control classes were those which did not have the films. Throughout the remainder of this report the experimental classes are referred to as X groups and the control classes as C groups. With three or four exceptions the X and C classes were in different school buildings in each city; and there was practically no contact between X and C students or teachers during the experiment.

Coöperating cities. The experiment began about the first week in February and continued until about the middle of May, 1928. The twelve cities coöperating in this enterprise were distributed widely over the United States, with Newton, Massachusetts, Rochester, New York, New York City, New York, Winston-Salem, North Carolina, and Atlanta, Georgia, in the East; Detroit, Michigan, Chicago, Illinois, Lincoln, Nebraska, and Kansas City, Missouri, in the Central States; Denver, Colorado, in the Mountain States; and Oakland, California, and San Diego, California, on the Pacific Coast.

Areas of learning. The areas of instruction included ten topics in General Science and ten topics in Geography. They were selected as being among the most commonly accepted topics in General Science and Geography curricula of American schools. A list of the topics in each field in the order in which they were presented follows:

Geography	General Science
1. New England Fisheries — Cod	1. Hot Air Heating
2. Wisconsin Dairies	2. Atmospheric Pressure
3. Wheat	3. Compressed Air
4. Wheat to Bread	4. Water Cycle
5. Cattle	5. Water Supply
6. Corn	6. Purifying Water
7. Cotton Growing	7. Limestone and Marble
8. Irrigation	8. Sand and Clay
9. Bituminous Coal	9. Reforestation
10. Iron Ore to Pig Iron	10. Planting and Care of Trees

Certain of these topics had been studied by the children in some of the cities before the experiment began, but it seems fair to assume that the repetitions were equal in numbers for the X and C groups in any given city. Since our comparisons are between X and C groups only, it is quite unlikely that the findings are vitiated in any way by these repetitions.

Study Guides. As indicated above, the validity of comparisons of the X and C classes depends upon the extent to which the courses of study involved are adequately defined and delimited, and upon the extent to which students and teachers in the X and C groups stay within the areas of instruction agreed upon. Obviously it would not do simply to list the ten general topics in General Science and in Geography. Two twelve-weeks' courses might easily be organized around these topics without having any great community of details or of treatment. In order, therefore, to delimit areas of instruction concretely enough to form the basis of valid tests and to insure that all students in both groups would spend the twelve weeks allotted to the experiment on the same specific body of study materials, detailed Study Guides were prepared on each of the topics in General Science and in Geography. A copy of these Study Guides was given to each child in the X and C groups. The Study Guides were all uniform in plan of organization and included from four to six subheads with second- and third-order items under each subhead, together with notes giving, in highly compact form, interesting and arresting information about various phases of the general topic. The Study Guides averaged about five to seven pages on each topic, so that in General Science the students had as a syllabus for this course a booklet of sixty pages, while the Geography students had a syllabus of sixty-nine pages.

The definition of the areas of instruction to be studied by both the X and C groups is of such fundamental importance for the comparisons between the progress and achievements of the X and C groups that it seems advisable to let the reader see for himself at least one study guide in General Science and one in Geography in precisely the form in which they were presented to the students. With this in mind we are presenting the Study Guide on the first topic in General

Science and the Study Guide on the first topic in Geography. In addition, we are presenting in the appendix the remaining eighteen Study Guides in outline form, including only the major subheads of each guide.

HOT AIR HEATING

(Study Guide for all pupils in General Science)

I. General Survey.

a. Be prepared to discuss:

(1) Advantages of the fireplace over the open campfire.

(*a*) in carrying away smoke.

(*b*) in distributing heat.

(*c*) in controlling the fire.

(2) Advantages of a stove over a fireplace.

(*a*) in saving heat.

(*b*) in extent of surface for radiating heat.

(3) Advantages of a jacketed stove over the ordinary stove.

(*a*) in distributing currents of heated air.

(*b*) in making all parts of a room comfortable.

(4) Advantages of a piped furnace over a jacketed stove.

(*a*) in the number of fires needed to heat a large house.

(*b*) in securing a uniform temperature for all the rooms in a large house.

(*c*) in regulating the temperature of each room in a large house.

(5) The use of automatic regulators.

(*a*) What they are intended to do.

(*b*) How they work.

b. Prepare for report the topic assigned your group from the following list:

(1) Ways in which heat is transferred.

(2) Advantages and disadvantages of a fireplace.

(3) The evolution of the stove.

(4) "What I learned while tending the heating plant."

II. The Production of Heat.

a. Be prepared to discuss:

(1) Radiation of energy by fire.

(*a*) How a fire affects a hand held near it.

(*b*) How energy from the fire reaches the hand.

(2) The transformation of energy into heat.

(*a*) What becomes of the energy when a metal screen is placed between the hands and the fire.

(*b*) A demonstration to show that if two sheets of glass, one clear, the other blackened are exposed to the sun for a time, the blackened piece will be warmer than the other.

(*c*) Why it is cooler in the shade than in the sun on a warm summer day.

(3) The production of air currents.

(*a*) How air is heated by a fire.

(*b*) How upward currents of air over a fire are produced.

(*c*) How currents of cool air flowing toward a fire are produced.

(*d*) A demonstration to show that fire causes a draft. The demonstration is to be made by cutting two holes about an inch in diameter, one in each end of one side of a chalk box. The box is placed on its side with the holes on top and a lighted candle is set under one of the holes. A lamp chimney is placed over each hole and a glass slide is inserted in place of the cover. To show the draft caused by the candle flame a bit of smoking paper is held over the other chimney. Note the similarity of conditions in the chimney of a fireplace and explain cause of convection currents.

(*e*) A demonstration to show how heat is transferred. The demonstration is made by fastening to a ringstand three equal-length rods of copper, iron, and glass, which previously have been warmed and dipped in paraffin. A lighted burner is placed under

them, an inverted pinwheel is fastened at the top of the ringstand, and a radiometer is placed a foot away from the burner. What does the rate at which the wax melts and drips from the rods show? What does the turning pinwheel show? What does the radiometer show?

III. The Distribution of Heat.

a. Be prepared to discuss:

(1) The effect of a screen before a fireplace.
- (*a*) on the radiant energy.
- (*b*) on the air currents.
- (*c*) on the distribution of heat.

(2) The effect of wrapping a screen about a fire to form a stove.
- (*a*) How a fireplace is like a screen partly enclosing a fire.
- (*b*) How a stove is like a screen enclosing a fire almost completely.
- (*c*) Why a stove is a more convenient heating device than an open fireplace.
- (*d*) How the fire in a stove is regulated.
- (*e*) How air let into a stove above the fire box affects the fire.
- (*f*) Why stoves are usually made of iron.
- (*g*) How a Nuremberg stove, with a very small fire box and very thick walls of brick and porcelain, heats a room.

(3) The effect of a jacket about a stove.
- (*a*) on energy radiated from the stove.
- (*b*) on air currents about the stove.
- (*c*) on the distribution of heat to a room.
- (*d*) Why a jacketed stove heats a room by convection rather than by radiation.

Note — The commercial heating circulating stoves are equipped with a jacket which stops the energy radiated by the stove. The cool air of the floor level is heated between the stove and the jacket and discharged through the opening at the top. Warm air circulates as convection currents. A water pan in the stove gives the warm air the proper amount of moisture.

The low temperature of the outside jacket prevents accidental burns.

IV. Hot Air Heating.

a. Be prepared to discuss:

(1) The hot air furnace.

(*a*) The essential parts of a furnace.

(*b*) How hot air is distributed from a heating furnace.

(*c*) How the hot air furnace differs from the jacketed stove.

(*d*) Why furnace heating is more economical of fuel than stove heating.

(*e*) Why furnace heating is more convenient than stove heating.

(2) The water pan in a hot air furnace.

(*a*) What the water pan in a hot air furnace is.

(*b*) How the water pan works.

(*c*) Why moisture is added to the air heated by the furnace.

(3) Regulation of temperature.

(*a*) How the heating effect of a campfire is regulated.

(*b*) How the heating effect of a furnace is regulated.

(*c*) What the advantages of an automatic regulator are.

(*d*) Why it is desirable to keep the temperature of a room at 68° F.

(*e*) Why it is more economical to keep a room at a constant temperature than to permit it to fluctuate between 50° and 75° F.

V. Reorganization Review.

a. Be prepared to make report on topic assigned you and to discuss reports of other pupils.

b. Be prepared to summarize the evidence that increased efficiency has marked the development of heating devices by describing:

(1) How the development of heating devices shows —

(*a*) increased economy of fuel.

(*b*) increased convenience in operation.

(*c*) increased uniformity in heating.

(2) How the development of heating devices has promoted —

(*a*) human health and comfort.

(*b*) man's working efficiency.

Note — Man first warmed himself by an open fire wasting nearly all the energy from his fuel. Then he moved the campfire inside, making an exit for the smoke through the roof. Later the fire was placed at the lower end of a chimney built at one end of the house — the fireplace resulted. This was more convenient but caused drafts of cold air, and the convection currents set up were lost up the chimney. Finally an iron screen was wrapped about the fire. This device, called a stove, changed the radiant energy sent out by the fire to heat. Air in contact with it received heat by conduction and set up weak convection currents. Much heat was re-radiated by the screen and lost through glazed windows. Near the stove it was too hot and away from it too cold. A jacket placed about the stove stopped this re-radiated energy and guided the convection currents so that warm air was evenly distributed. The furnace resulted when this jacketed stove was placed in the basement with the top of the jacket extending into pipes to carry warm air to all parts of the house. Automatic controls of humidity and temperature increase the efficiency of the furnace.

c. *Make two large labeled diagrams comparing the hot air system with the hot water system. This should test your ability to apply the principles of hot air heating to a new problem. For both systems the diagram should be labeled to show:*

(1) How the heat gets from the fire to the inner screen of the furnace (Radiation).

(2) How the heat gets through the inner screen (Conduction).

(3) How the heat is taken up by the air or water outside the screen (Conduction).

(4) Why the warm air or water rises in the pipes to the rooms where the heat is wanted (Convection Currents).

(5) How, in the hot water system, the heat gets from the water in the radiator out into the room (Conduction and Radiation).

(6) A short footnote should give the advantages of each system over the other.

References:

Starr: *First Steps in Human Progress*; chapter on "Fire Making."

Current science textbooks.

Trade catalogues of heating equipment.

NEW ENGLAND FISHERIES — COD

(Study Guide for all Geography pupils)

I. General Survey.

a. Be prepared to discuss:

(1) Cod schooners.

(*a*) The type of vessel used for cod fishing.

(*b*) How cod schooners are built.

(*c*) What the schooner carries in her hold.

(2) Trawl fishing for cod.

(*a*) The appearance of a dory.

(*b*) How trawl lines are set.

(*c*) The size of cod fish.

(3) Preparation of cod for the market.

(*a*) How fresh cod are shipped.

(*b*) How salt cod are prepared for use.

(*c*) How cod are packed for market.

b. Trace on a map the route from Gloucester to the Grand Banks.

Note — Currents of warm air and water from the south and of cold air and water from the north meet off the eastern coast of North America opposite Newfoundland. Here lie the Grand Banks, over which the water is about 250 feet deep. Many kinds of fish find an abundance of food on the Grand Banks. Cod, hardy cold water fish rich in fats and oils, are caught there on long lines called trawls. Large numbers of haddock and halibut are also caught on the trawls.

The cod schooners anchor on the Grand Banks and send out dories to set the trawls. Owing to the meeting of the warm and cold currents of air, fogs and storms are frequent. It sometimes happens that the men in the dories cannot find the mother ship and are lost at sea. Schooners sometimes are unable to ride out the storms and are also lost.

Many steam trawlers are used now, but formerly sailing vessels only were used. The builders take pride in sending out boats that can weather the storms at sea and that can beat all other schooners to and from the fishing banks. New England shipyards have long been famous for building staunch wooden fishing schooners.

The Columbia was the pride of Gloucester and was recognized as the fastest boat fishing on the banks. In the summer of 1927 the Columbia set sail for the Grand Banks and was lost with all hands on board. No one knows what happened to her, but on New Year's Day 1928, the steam trawler Venosta, sailing under the command of Captain Myhre 115 miles out of Halifax over the fishing banks, and dragging the bottom of the Atlantic about 240 feet from the surface, caught the hulk of the Columbia with her powerful tackle and brought it to the surface. Captain Myhre states that the Columbia's masts were erect, and that her deck and sides were gleaming with a strange brilliancy as the powerful flood lights of the trawler lighted the shattered hulk. The three-inch steel cables of the Venosta were not strong enough to hold the unfortunate vessel and soon broke, and again the Columbia went to the bottom of the ocean.

Early in the fall, annually, a memorial service is held at Gloucester for all men lost at sea. Prominent people take part in the solemn exercises and thousands of flowers are cast on the waters in memory of brave men who go down to the sea in ships.

c. Be prepared to report to the class on the topic assigned you:

(1) The Grand Banks of Newfoundland.
(2) The life story of the cod.
(3) The history and importance of cod fishing.
(4) New England shipbuilding.
(5) The life of the Gloucester fishermen.

II. Fishing for Cod.

a. Be prepared to discuss:

(1) How fishing schooners are built.
- (*a*) Why the timbers of a schooner should be strong.
- (*b*) How the hull of a schooner is supported while the boat is being built.
- (*c*) How a schooner is launched.
- (*d*) When the masts are placed in a schooner.

(2) Schooners and dories.
  (*a*) Relative size of schooner compared with modern steamship.
  (*b*) Provisions and supplies for the voyage.
  (*c*) The advantages and disadvantages of wind power and steam power for fishing vessels.
  (*d*) The responsibility of the man at the wheel.
  (*e*) How dories are carried on a cod schooner and how launched.
  (*f*) How dories are used in cod fishing.

(3) Trawling
  (*a*) Why trawls are used instead of nets.
  (*b*) The trawl-line and its hooks compared with ordinary fishing-tackle.
  (*c*) How trawl hooks are baited.
  (*d*) How the trawl is set.
  (*e*) How the cod are taken from the trawl.

(4) Dangers met in fishing for cod.
  (*a*) Reasons for fogs on Grand Banks.
  (*b*) How fogs affect the work of fishermen in dories tending the trawls.
  (*c*) Why storms are frequent on the Grand Banks.
  (*d*) Why storms are likely to strike fishing schooners anchored on the Grand Banks.

(5) Taking the fish to port.
  (*a*) How cod are loaded on schooner from dories.
  (*b*) Why cod are dressed, and salted or iced on the schooner before they are taken to port.
  (*c*) Why cod fishermen want fast sailing schooners.
  (*d*) How cod fish are unloaded from a schooner.

b. Summarize the arrangements for catching and handling large quantities of cod fish.

Note — Fishing schooners are to-day the fastest and safest of sailing vessels. The dories are small flat-bottomed boats kept in "nests" on the schooner when not in use. They are used to set the trawls and to take the catch from them. A trawl is a very strong line, often a mile in length, to which short lines are attached. Hooks and sinkers are fastened to the ends of these short lines. The bait used is chunks of fish. The trawl, with a

floating buoy attached to each end, is anchored in the ocean by the dory. The fish are removed from trawls to dory from whence they are placed in hold of schooner. Fishermen on the schooner are busy long hours of the day and night dressing, salting, and icing the cod to keep them in good condition. Large numbers of both halibut and cod are caught on the trawl lines, and schooners have been known to return to port with over 300,000 pounds of fish. Cod fish vary in weight from two to fifty pounds.

III. PREPARING COD FISH.

a. Be prepared to discuss:

(1) Drying the cod.

(*a*) Why the salt is washed off.

(*b*) Appearance of the drying yard.

(*c*) The drying process.

(2) Preparing dried cod fish for packing.

(*a*) Skinning the cod.

(*b*) Boning the cod.

(3) Packing the cod fish.

(*a*) Hand-work and machine-work in packing.

(*b*) Appearance of the finished product.

b. Explain the need for the preservation of fish and summarize the processes employed in preserving cod.

NOTE — Fish are usually sold as fresh, salted, smoked, or canned. Salt cod are dried, skinned, boned, and packed in boxes of uniform weight. The huge drying racks at Gloucester are called "flakes." On these, the fish are spread out and turned repeatedly so that they may dry evenly. Skinning the cod and extracting the bones require skilled workers, some of whom can prepare a fish in less than a minute. Most of the important food fish are disappearing rapidly but cod fish seem to be as numerous as ever in spite of the large number caught annually.

IV. REORGANIZATION REVIEW.

a. Be prepared to present the report on your assigned topic and to discuss the reports of other pupils.

b. Summarize your study of the cod fishing industry by discussing the following points:

(1) How we are dependent upon the service of the cod fishermen.

(2) How their work requires hardihood and courage.

c. *Discuss how we are dependent upon the faithful services of people we may never know or see, including the following:*
   (1) The locomotive engineer.
   (2) The fire fighter.
   (3) The policeman.
   (4) The house builder.
   (5) The farmer.

d. *Write, in about ten sentences, what you consider the most important things you have learned from your study of cod fishing, giving reasons why you think those things most important.*

References:
Kipling: *Captains Courageous.*
Reports from United States Bureau of Fisheries.

The tests used. The written tests used in measuring the relative attainments of the X and C groups in this experiment were based strictly upon the areas of learning delimited by the Study Guides, and were parallel for the two courses of study. The tests in Geography and General Science were of two types. The first type, hereafter called Comprehensive Tests, included three subtests, which are hereafter called tests C1, C2, and C3. Test C1 consisted of one hundred true-false statements and was given only at the beginning of the experiment. Test C2 consisted of one hundred multiple-choice questions given both at the beginning and at the end of the experiment. Test C3 included approximately one hundred two-answer questions and was given only at the end of the experiment. The main purpose of Test C2, which was given both at the beginning and end of the experiment, was to measure the relative gains of the X and C students. The questions in this test emphasized ability to interpret experiences and to make inferences and judgments. Test C3, given only at the end, was designed to measure the ability of the students to recall concrete ob-

jects and processes which were indicated in the Study Guides and were also pictured in the films. The second type of test used, hereafter called Topical Tests, was a modified form of the traditional essay examination which is subjectively scored. The Topical Tests were given approximately every two weeks during the experiment. Each of these tests included about eighteen questions and covered the subject matter of two topics.

The Comprehensive and Topical Tests constituted two independent series of tests, the first having been in charge of one of the authors in New York City and the second in charge of the other author in Chicago. The questions in each part of both series of tests were about equally divided between the ten topics in each course of study. A detailed description of the construction, administration, and scoring of the Comprehensive Tests is given in Chapter II, and of the Topical Tests in Chapter V, and both series of tests are reproduced in full in Appendices II to V, inclusive.

Directions to teachers. Just before the experiment began, each of the twelve cities excepting the two in the far west were visited by one or the other of the writers, and conferences were held with the X teachers and with the C teachers in separate groups, or with the supervisors and officers in charge of the experiment. The general plan of the experiment was explained in detail, and particular stress was laid upon the necessity for both X and C teachers staying within the limits prescribed by the Study Guides. They were also urged to keep to the time schedule with meticulous care. The C teachers were not only allowed, but were urged to use all pedagogical devices that they desired to use, save only motion pictures. As we shall see later, the C teachers availed themselves extensively of this provision by using all manner of maps, charts, pictures, diagrams, and lantern slides.

The teachers in both groups were urged to carry on the classroom exercises in a normal and natural way, and in so far as possible to allow the children to maintain a normal attitude toward this part of their school experience. It seemed particularly desirable to avoid any sense of excessive rivalry between the X and C groups, and it was with this object in view that the teachers were asked to maintain a normal attitude in the classroom, treating the course of study prescribed for this experiment just as though it were prescribed by local school authorities. This injunction largely failed of its purpose in several of the cities because a feeling of intense rivalry developed almost immediately.

Experimental Teachers' Guides. As an aid to the X teachers in adjusting classroom procedure to the exigencies of an unfamiliar classroom instrument, Teachers' Guides were constructed for the exclusive use of the X teachers. These guides included only the major subheads and the notes of arresting bits of information from the Study Guides. In addition they included brief directions to the X teachers as to how and when to use the films.

In addition to the Teachers' Guides a brief memorandum entitled "General Guide for Experimental Teachers" was sent to each X teacher explaining the purpose of the experiment in general terms and giving more or less explicit directions as to the use of the Teachers' Guides and of the films. These directions relative to the use of the films were the only aids given which were not also given to the C teachers. Without further comment we reproduce a copy of this General Guide for X teachers, together with the X Teachers' Guide and Film Script for the first topic in General Science and for the first topic in Geography.

GENERAL GUIDE

(For experimental teachers)

INTRODUCTION.

An investigation to determine the educational value of certain classroom films is being conducted in the schools of twelve widely separated cities in the United States. The results obtained in teaching experimental groups with the aid of films and control groups without the aid of films will be tested and compared by Dr. Ben D. Wood of Columbia College, Columbia University, and Dr. Frank N. Freeman of the School of Education, University of Chicago.

Teachers in the control classes should follow their usual methods of instruction and should not be influenced in any way by methods used in the experimental classes. Film scripts, films, General Guide, and Teachers' Guides, therefore, are for the exclusive use of the experimental teacher. Each Teachers' Guide carries the heading "For the confidential use of the teacher of the experimental group."

TEACHERS' GUIDES.

A Teachers' Guide and a Study Guide have been issued for each film used in the investigation. *The Teachers' Guides are for the exclusive use of teachers conducting classes with the aid of classroom films.* The Study Guides are for the use of all teachers and pupils in both experimental and control groups. Both sets of guides indicate specifically the area of instruction to be covered and the line of thought to be developed. This limitation of instruction is necessary in order that the results obtained from experimental and control groups in widely separated schools may be comparable.

FILM UNITS.

The scenes in an Eastman Classroom Film are grouped into sections, each section forming a film unit. While the film units are closely knit together to form a unified whole, each unit is practically self-contained, and may be readily understood when shown apart from the rest of the film. A brief description of the area covered by the film units in each film is given at the beginning of the special guide for that film. The descriptions indicate to the teacher the material available in the film, and the order in which it is arranged.

Key Statements.

A teaching film serves its best purpose when it supplies concrete data as a basis for inference and generalization. It is intended to afford pupils information of a direct and accurate kind, and at the same time to stimulate thinking. Pupils are not expected to retain distinct impressions of every detail shown in the picture. "Selective seeing" is as important as "selective reading" in the study process. Inferences which underlie and give meaning to groups of details are in the end more valuable than the details from which they are derived. The guides are built upon the assumption that a few closely related observations used as data from which to draw inferences and conclusions have higher educational value than a much more extensive list of random observations, the meanings and implications of which are not made clear. The line of thought to be developed in connection with each film is presented in the Teachers' Guides in a series of propositions under the heading of "Key Statements." These statements serve to indicate the direction in which the attention of pupils is to be pointed and to lay down the theme for observations and discussions at each stage in the progress of the instruction.

Approach.

The use of classroom films does not involve any drastic change in good teaching practice, the fundamental features of which are the same no matter what media of instruction are employed. Teachers realize that directing the study of a topic means vastly more than ordering a class to read the next five pages of a text. It involves a recall and comparison of experiences, a stimulation of personal interest, and a definite fixation of attention. The same considerations apply, with even greater force, to instruction with the aid of classroom films. Under the heading "Approach" in each Teachers' Guide is suggested one way to introduce the topic treated in the film. Each teacher will vary the approach to meet special circumstances and local backgrounds. Extrinsic objectives, however, such as making good grades, surpassing other groups, or meeting tests, should be avoided. Approach should be made in such a way as to relate the topic to pupil experience, arouse interest in it, and instill a real desire to learn more about it.

Presentation of Whole Film.

The standard practice adopted is to show the whole film first,

then to re-show the film units in the order in which they occur. The first item in the presentation states what the pupils are to note as they follow the whole film on the screen. It embodies the idea set forth in the first key statement. The discussion after the showing of the film as a whole should be brief and should be confined to a report on observations made in accord with directions given before the showing. Minor details should be ignored and no attempt made at this point to draw inferences or to discuss reasons. The main purpose of showing the film as a whole is to give pupils an opportunity to get a general idea of the contents of the picture, and to fix the larger points in mind before proceeding to a study of details. The discussion of the film as a whole should prepare the minds of the pupils for reading assignments or other types of outside work. These assignments should be made early in the development of the topic in order that pupils may have time to report before a new topic is begun.

Presentation of Film Units.

A summary of the observations and discussions of the film as a whole furnishes the approach to the showing of the first film unit, just as a summary of the observations and discussions following the review of each film unit serves as an introduction to the unit following. While the discussion of the picture as a whole should deal primarily with reports on observations, increasing emphasis should be placed upon the drawing of inferences and conclusions as the discussions of the films proceed. As a safeguard against loose thinking in the discussions, the teacher should require that all inferences and conclusions be based upon observed facts. Just before each re-showing of a film unit directions are given to the pupils for viewing it. These directions represent re-statements of propositions in the "Key Statements."

Reorganization Review.

The final key statement indicates the main conclusion to be drawn from the observations, discussions, and reports on assignments. The development of this main conclusion affords opportunity to review the whole situation by reorganizing the data about some significant center. Instead of reviewing the points by means of simple repetition, the reorganization review uses the points developed to build them into a generalization which fixes them in memory by orderly association, and serves as a pattern of

thought by means of which the meaning of similar situations may be interpreted.

Instruction.

The teacher should translate the various directions into language that is within the range of understanding of the pupils. When the guide, for example, says, "Direct pupils to look for evidence, etc.," it is assumed that the teacher will not be content simply to repeat the direction. The minds of the pupils should be so prepared and their attention so directed that they will look for the evidence indicated. Another outstanding problem of the teacher giving instruction with the aid of films, is to lead pupils to translate visual images into appropriate words, and to interpret in verbal forms, the meanings of things. Normally, vocabulary drill should follow, not precede, the images seen and ideas to which they refer. Readings, pictures, and other instruction material should be used freely. One evidence of effective instruction is that it stimulates further reading, and that it makes the reading more meaningful.

HOT AIR HEATING

(Guide for experimental teachers in General Science)

Synopsis for Teacher

Film Units.

1. The first film unit: Interior of hunting lodge with hunters about fireplace warming themselves — smoke currents indicate drafts — an iron screen placed for a short time before the fire becomes heated — actions of the hunters indicate that the room is very unevenly heated — animated air currents indicate direction of draft.

2. The second film unit: Interior of a country school heated by a stove — pupils indicate that near the stove it is too warm and away from it too cold — an iron jacket is placed about the stove — animated drawings show the improved circulation of warm air due to jacket.

3. The third film unit: Interior of a modern school with a hot air furnace installed in the basement — the construction of the furnace, thermostat control, heat distribution, and ventilation, are shown — the unit ends with scenes contrasting the campfire, fireplace, baseburner, and hot air furnace as heating devices.

Key Statements.

1. Distinct advances have been made in the development of heating devices.

2. When the energy radiated by fire is stopped it becomes heat.

3. A jacket about a stove may be used effectively to distribute heat throughout a room.

4. Heat may be distributed to many rooms by means of pipes leading from a jacketed stove.

5. Increased efficiency has marked the development of heating devices.

First Period

Approach.

1. Have the pupils recall interesting experiences with campfires, fireplaces, stoves, and furnaces. Discuss, with regard to each device, the features which pleased them; the features with which they were dissatisfied.

Presentation.

I. Direct pupils to look for evidence, while viewing the film as a whole, that advances have been made in the development of heating devices; then show the film as a whole.

a. *Have the pupil recall observations that bear on the following points:*

(1) Advantages of the fireplace over the open campfire.

(2) Why a stove is more economical than a fireplace.

(3) Why the jacketed stove is an improvement over the ordinary stove.

(4) The added convenience of having the stove in the basement with the outside jacket extending into pipes which carry the warm air to the rooms above.

(5) Further advances with which the pupils are familiar in the development of heating devices.

b. *Divide the class into four groups and assign to each group one of the following topics for report:*

(1) Ways in which heat is transferred.

(2) The advantages and disadvantages of the fireplace as a heating device.

(3) The evolution of the stove.

(4) "What I learned while tending the heating plant."

Note — Ask each pupil in this group to care for his home

heating plant for at least two days, building fires, tending them, etc.; and to bring his experiences to class in the form of a written report.

Second Period

II. Direct the pupils to look for evidence, while reviewing the first film unit, that fire radiates energy which, when stopped, becomes heat; then show the first film unit down to the title, "A stove is an iron screen wrapped about a fire."

a. Have pupils recall and discuss observations that bear on the following points:

(1) Evidence that fire in a fireplace radiates energy.

(2) Evidence that radiant energy, when stopped, becomes heat.

NOTE — Have demonstration made before class to show that if two sheets of glass, one clear, the other blackened, are exposed to the sun for a time, the blackened piece will be considerably warmer than the other.

(3) Evidence that fire causes a draft.

NOTE — To show that fire causes a draft have a pupil make a demonstration by cutting two holes about an inch in diameter, one in each end of one side of a chalk box. Place the box on its side, the holes on top, and set a lighted candle under one of the holes, place a lamp chimney over each hole, and insert a glass slide in the side of the box in place of the cover. To show the draft caused by the candle flame, hold a bit of smoking paper over the other chimney. Bring out the similarity of condition in the chimney of the fireplace and introduce the idea of cause and nature of convection currents.

NOTE — Have another pupil demonstrate methods of heat transfer by fastening to a ringstand three equal-length rods of copper, iron, and glass, which previously have been warmed and dipped in paraffin. Place a lighted burner under them. Fasten an inverted pinwheel at the top of the ringstand, and a foot away from the burner place a radiometer. The rate at which the wax melts and drops from the rods shows the relative conductivity of copper, iron, and glass; the turning pinwheel shows convection currents; and the radiometer shows radiant energy.

III. Direct pupils to look for evidence, while reviewing the second film unit, that a jacket about a stove may be used effectively to distribute heat throughout a room; then show the second

film unit down to the title, "This modern school has a stove in the basement."

a. Have pupils recall and discuss observations that bear on the following points:

(1) The effect of the screen before the fireplace in unit one.

(2) The effect of wrapping a screen completely about a fire to form a stove.

(3) How a jacket about a stove affects the distribution of heat.

Note — Commercial heat circulating stoves are equipped with a jacket which stops the energy radiated by the stove. The cool air of the floor level is heated between the stove and the jacket and discharged through an opening at the top. Warm air circulates as convection currents. A water pan in the stove gives the warm air the proper amount of moisture. The low temperature of the outside jacket prevents accidental burns.

Third Period

IV. Direct the pupils to look for evidence, while reviewing the third film unit, that heat may be distributed to many rooms by means of pipes leading from a jacketed stove; then show the remainder of the film.

a. Have the pupils recall and discuss observations that bear on the following points:

(1) Evidence that a furnace is a jacketed stove.

(2) How moisture is added to the air.

(3) How the temperature of a room is regulated automatically.

V. Reorganization Review.

a. Have assigned reports made and discussed.

b. Have pupils summarize the evidence that increased efficiency has marked the development of heating devices by describing:

(1) How the development of heating devices shows —

(*a*) increased economy of fuel.

(*b*) increased convenience in operation.

(*c*) increased uniformity in heating.

(2) How the development of heating devices has promoted —

(*a*) human health and comfort.

(*b*) man's working efficiency.

Note.— Man first warmed himself by an open fire, wasting nearly all the energy from his fuel. Then he moved the campfire inside, making an exit for the smoke through the roof. Later the fire was placed at the lower end of a chimney built at one end of the house — the fireplace resulted. This was more convenient but caused drafts of cold air, and the convection currents set up were lost up the chimney. Finally an iron screen was wrapped about the fire. This device, called a stove, changed the radiant energy sent out by the fire to heat. Air in contact with it received heat by conduction and set up weak convection currents. Much heat was re-radiated by the screen and lost through glazed windows. Near the stove it was too hot and away from it too cold. A jacket placed about the stove stopped this re-radiated energy and guided the convection currents so that warm air was evenly distributed. The furnace resulted when this jacketed stove was placed in the basement with the top of the jacket extending into pipes to carry warm air to all parts of the house. Automatic controls of humidity and temperature increase the efficiency of the furnace.

c. *Have the pupils make two large labeled diagrams comparing the hot air system with the hot water system. This should be so assigned as to test the pupils' ability to apply the principles of the preceding lesson unit to a new problem. Both diagrams should be labeled to show:*

(1) How the heat gets from the fire to the inner screen of the furnace (Radiation).
(2) How the heat gets through the inner screen (Conduction).
(3) How the heat is taken up by the air or water outside the screen (Conduction).
(4) Why the warm air or water rises in the pipes to the rooms where the heat is wanted (Convection Currents).
(5) How, in the hot water system, the heat gets from the water in the radiator out into the room (Conduction and Radiation).
(6) A short footnote should give the advantages of each system over the other.

References:

Starr: *First Steps in Human Progress;* chapter on "Fire Making."
Current science textbooks.
Trade catalogues of heating equipment.

Hot Air Heating

(Film script scenes and titles as they appear in the film)

Exterior of hunting lodge.
Interior of hunting lodge.

Fire radiates energy.

Continue interior of hunting lodge.

When radiant energy is stopped, it is changed into heat.

Continue interior of hunting lodge.
Close-up of hands touching fire screen.
Continue interior of hunting lodge.

Fire causes draft.

Continue interior of hunting lodge.
Close-up of fire showing draft.
Continue interior of hunting lodge.
Begins phantom animation from still photograph and continues line animation showing heat radiation in hunting lodge and fades back to still.
Exterior of country school.
Interior of country school.

A stove is an iron screen wrapped about a fire.

Continue interior of country school.

It is too hot near the stove and away from it too cold.

Continue interior of country school.

An iron jacket about a stove helps to distribute heat evenly.

Close-up of stove — boys putting screen around it.
Phantom animation from still photograph of country school stove and continue line animation of heat radiation.
Close-up of country school stove with screen around it.

This modern school has a stove in the basement.

Exterior of modern school.
Close-up of hot air furnace — man opens furnace.
Phantom animation from still photograph of furnace and continue line animation — end phantom animation to still.
Close-up of furnace — man puts coal on the fire.

Panoram follow shot of hot air carriers on wall.
Interior modern school showing teacher and children.
Interior same showing circling to thermometer on the wall.

Regulating the temperature.

Close-up of thermometer.

The thermostat is back of the thermometer.

Close-up shows thermostat behind thermometer.
Animation of automatic temperature regulation.
Medium shot of damper at entrance to furnace.
Close-up of damper in action.

Moisture is added to the air.

Close-up of furnace.
Begin phantom animation and continue line animation showing operation of water pan — end phantom animation.
Close-up of intake vent into school room. Panoram down to outlet vent in bottom of door.
Interior of modern school room.

From camp fire to heating furnace marks one line of human progress.

Exterior camp scene.
Exterior of Vermont home.
Interior — family huddled about coal stove.
Interior of comfortable living room with concealed radiators.

NEW ENGLAND FISHERIES — COD

(Guide for experimental teachers in Geography)

Synopsis for Teacher

FILM UNITS.

1. First film unit: Building fishing schooner — schooner sets sail for the Grand Banks — trawls are laid for catching cod from the deep sea — fish are collected from the trawls by men in dories and loaded on schooner — schooner returns to port and unloads cargo of fish.

2. Second film unit: Fresh cod are iced — salt cod are dried on racks, boned, and packed. The Columbia sets sail for the banks on the voyage from which she never returns.

Key Statements.

1. Cod fish are caught from the deep sea on trawls and are marketed as either fresh or salt cod.
2. Cod fish are caught in large numbers on the Grand Banks.
3. Cod fish are preserved by drying.
4. We are dependent upon the faithful service of many people whom we may never know or see.

First Period

Approach.

1. Discuss with pupils the value of fish as a food, mentioning some kinds best liked.
2. Have pupils describe some of the methods of catching fish.

Presentation.

I. Immediately before showing film direct pupils to note, in order, steps taken in catching and preparing cod fish for market; then show film as a whole.

a. *Have pupils recall observations that bear on the following points:*

(1) Cod schooners.

(2) Trawl fishing for cod.

(3) Preparation of cod for the market.

b. *Have pupils trace on map routes taken from Gloucester to the Grand Banks.*

Note — Currents of warm air and water from the south and of cold air and water from the north meet off the eastern coast of North America opposite Newfoundland. Here lie the Grand Banks, over which the water is about 250 feet deep. Many kinds of fish find an abundance of food on the Grand Banks. Cod, hardy cold water fish rich in fats and oils, are caught there on long lines called trawls. Large numbers of haddock and halibut are also caught on the trawls.

The cod schooners anchor on the Grand Banks and send out dories to set the trawls. Owing to the meeting of the warm and cold currents of air, fogs and storms are frequent. It sometimes happens that the men in the dories cannot find the mother ship and are lost at sea. Schooners sometimes are unable to ride out the storms and are also lost.

Many steam trawlers are used now, but formerly sailing vessels only were used. The builders take pride in sending out

boats that can weather the storms at sea and that can beat all other schooners to and from the fishing banks. New England shipyards have long been famous for building staunch wooden fishing schooners.

The Columbia was the pride of Gloucester and was recognized as the fastest boat fishing on the banks. In the summer of 1927 the Columbia set sail for the Grand Banks and was lost with all hands on board. No one knows what happened to her, but on New Year's Day 1928, the steam trawler Venosta, sailing under the command of Captain Myhre 115 miles out of Halifax over the fishing banks, and dragging the bottom of the Atlantic about 240 feet from the surface, caught the hulk of the Columbia with her powerful tackle and brought it to the surface. Captain Myhre states that the Columbia's masts were erect, and that her deck and sides were gleaming with a strange brilliancy as the powerful flood lights of the trawler lighted the shattered hulk. The three-inch steel cables of the Venosta were not strong enough to hold the unfortunate vessel and soon broke, and again the Columbia went to the bottom of the ocean.

Early in the fall, annually, a memorial service is held at Gloucester for all men lost at sea. Prominent people take part in the solemn exercises and thousands of flowers are cast onto the waters in memory of brave men who go down to the sea in ships.

c. *Divide the class into five groups, assigning one of the following topics to each group:*
   (1) The Grand Banks of Newfoundland.
   (2) The life story of the cod.
   (3) The history and importance of cod fishing.
   (4) New England shipbuilding.
   (5) The life of the Gloucester fishermen.

Second Period

II. Direct pupils to note, as they view again the first film unit, how cod fish are caught in large numbers on the Grand Banks; then show first film unit as far as title "Salt Cod."
   a. *Have pupils recall and discuss observations that bear on the following points:*
      (1) Shipbuilding.
      (2) Schooners and dories.
      (3) Trawling.
      (4) Dangers met in fishing for cod.

(5) Taking the fish to port.

b. Have pupils summarize the arrangements for catching and handling large quantities of cod.

NOTE — Fishing schooners are to-day the fastest and safest of sailing vessels. The dories are small flat-bottomed boats kept in "nests" on the schooner when not in use. They are used to set the trawls and to take the catch from them. A trawl is a very strong line, often a mile in length, to which short lines are attached. Hooks and sinkers are fastened to the ends of these short lines. The bait used is chunks of fish. The trawl, with a floating buoy attached to each end, is anchored in the ocean by the dory. The fish are removed from trawls to dory from whence they are placed in hold of schooner. Fishermen on the schooner are busy long hours of day and night dressing, salting, and icing the cod to keep them in good condition. Large numbers of both halibut and cod are caught on the trawl lines, and schooners have been known to return to port with over 300,000 pounds of fish. Cod fish vary in weight from two to fifty pounds.

Third Period

III. Direct pupils to note, as they view again the second film unit, how cod are preserved for future use; then show remainder of the film.

a. Have pupils recall and discuss observations that bear on the following points:

(1) Drying cod fish.

(2) Preparing dried cod fish for packing.

(3) Packing cod fish.

b. Have pupils explain need for the preservation of fish and summarize processes employed in preserving cod for future use.

NOTE — Fish are usually sold as fresh, salted, smoked, or canned. Salt cod are dried, skinned, boned, and packed in boxes of uniform weight. The huge drying racks at Gloucester are called "flakes." On these, the fish are spread out and turned repeatedly so that they may dry evenly. Skinning the cod and extracting the bones require skilled workers, some of whom can prepare a fish in less than a minute. Most of the important food fish are disappearing rapidly but cod fish seem to be as numerous as ever in spite of the large number caught annually.

Fourth Period

IV. Reorganization Review.

a. *Have assigned reports given and discussed at this time.*

b. *Have pupils review and discuss:*

(1) How we are dependent upon the service of cod fishermen

(2) How their work requires hardihood and courage.

c. *Have pupils discuss how we are dependent upon the faithful services of many people whom we may never know or see.*

(1) The locomotive engineer.

(2) The fire fighter.

(3) The policeman.

(4) The house builder.

(5) The farmer.

NOTE — This list may be extended as far as seems profitable to the teacher in the time available. The work of the New England fisherman, in the face of hardships and dangers, is a striking example of faithful service and serves to introduce to pupils a realization of the fact that people are dependent upon each other for health, comfort, and safety.

d. *Have pupils write, in about ten sentences, what they consider the most important things they have learned from the study of cod fishing, giving reasons why they consider those things important.*

References:

Kipling: *Captains Courageous.*

Reports from the United States Bureau of Fisheries.

NEW ENGLAND FISHERIES — COD

(Film Script)

Fishing schooner under full sail leaving harbor.
Skipper at helm on fishing schooner.
General view of Gloucester Harbor.

Stout ships are built to brave the storms at sea.

Essex shipyard where Gloucester fishing fleets have been built (series of dissolves, 3 scenes).

In Gloucester Harbor.

General view of fishing boats in Gloucester Harbor showing Gloucester in the background.
Fade in. Map of New England and the North Atlantic, to include the Newfoundland Banks. Animate in succession Boston and Gloucester. From Gloucester animate in line to Georges Banks.
Medium view of preparations of fishing schooner for departure and loading of supplies on board.
Medium view of the same.
Taking ice on board.
Salt passing down chute into hold of schooner.

The staunch Columbia sets sail for the fishing banks.

Close-up of schooner showing name Columbia. Preparations continued.
Columbia leaving dock.
Columbia leaving harbor.
Medium view on board the Columbia.
Close-up of hoisting top sail.
Columbia under full sail.
The same.
Close-up of examining of trawl lines.
Close-up of hooks on trawl line.
Cutting up bait.
Close-up of dried fish bait.
Cutting up bait.
Baiting the trawl hooks.
Close-up of same.
Close-up of trawl hooks.
Close-up of baiting of trawl hooks.

At the fishing banks.

Sounding on the banks.
Launching the dory.
Setting the trawl.
The same.
The same.
Casting the trawl anchor.

Cod and halibut are taken from the trawling line.

Hauling in the trawl.
The same.

Dory approaches "Mother" ship.
Transferring fish to the "Mother" ship
The same.
The same.
The same.
The same.

The Columbia returns with 306,000 pounds of fish.

The Columbia homeward bound.
Columbia entering Gloucester Harbor — crew cheering for record catch.
The same.
Close-up of Columbia docking at Gorton-Pew pier.
Long shot of Columbia unloading at Gorton-Pew pier.

Fresh fish are packed for distant cities.

Packing and icing fish in barrels.
The same.

Salt cod.

Columbia unloading.
Close-up of hoisting salted cod from the hold of the Columbia.
Baskets of dried cod arrive on pier.
Close-up of same.
General view of work on pier.
Close-up of weighing salted cod.
The same.
Washing excess salt from cod.
Medium view of drying cod on flaking stands showing man turning fish.
Distant view of many workers turning fish.
Close-up of single worker turning fish.
Interior of Gorton-Pew plant — champion skinner skinning a cod in forty-one seconds.
Close-up of girl boning cod.
Close-up of girl's hands showing extracting bones from cod with special pliers.
Close-up of girl boning cod.
Cutting up cod for packing.
Close-up of same.
Weighing and boxing cod.

Close-up of same.
Machine pressing fish into boxes.
The same.
Girls wrapping and sealing packages of boneless cod.
Close-up of same.

The Columbia sets sail again never to return.

Close-up of the Columbia just before sailing.
View on board the Columbia after she leaves the wharf — crew cheering.

(Note — this is the crew that was lost.)

Columbia leaving Gloucester Harbor on her last trip.
On board the Columbia leaving harbor.
Columbia at sea.

(Note — Last photograph taken of the Columbia as she heads out to sea for the Grand Banks.)

The same.

Annual memorial services for Gloucester fishermen lost at sea.

Bugler blowing taps.
Girl scouts casting flowers upon the water.
Medium close-up of flowers floating on the water.
"Man at the Wheel" — Memorial statue for Gloucester fishermen.
Close-up of inscription "They that go down to the sea in ships."
On board Columbia leaving Gloucester on her last trip.

Character of films used in this experiment. It cannot be too strongly emphasized that this experiment was not concerned with educational films in general, but with a particular set of ten films in General Science and a particular set of ten films in Geography. The indications and conclusions of this experiment can be carried over to the general run of educational films only in so far as such films and their use are similar to those used in this investigation.

The reader may get a general notion of the character of the films used in this experiment by studying the sample Film Scripts reproduced above. No word picture can give

an adequate idea of any film, but we can indicate the general pedagogical characteristics of these films. In the first place, they are predominately devoted to material that is essentially characterized by motion of one sort or another. The films were built to conform to scenarios which had been written with definite pedagogical goals in view. No material was included in these films merely because it happened to be available in the commercial or other sources of film material. The films tell no story and present no drama other than that which inheres in motion pictures of concrete things, places, and actions. They are not entertainment films, though all who view them find them exceedingly interesting. The films were designed to stimulate close observation and to provoke, in the minds of the pupils, insistent questions, the answers to which the pupils were encouraged and helped to formulate for themselves. The educational values of such questions might easily be impaired or destroyed by putting authoritative answers to them in the films, either in subtitles, or in pictures, or diagrams. But in consonance with the wise warning of Professor Kilpatrick against such "vaccination of children against education," the editors of the Eastman films have carefully avoided giving *ex cathedra* answers to the questions provoked by the films. It was partly for this reason that the titles were reduced to a minimum. In these films the effort was made to avoid pedagogical tasks which can be better accomplished by other media of instruction.

The fact that these films tell no stories and present no dramatic sequences similar to those of the entertainment films is of such pedagogical importance as to require special emphasis, because it indicates more clearly than any other single feature of these films, the place which the present experimenters consider motion pictures ought to have in the classroom. In the theater film we have a self-contained

and complete unit, having a definite beginning and having a still more definite and satisfying ending which tends to discourage further thought about the matter on the part of the audience. The classroom film with which we are here concerned is not a self-contained unit carrying its own story which the student is to receive passively, and least of all is it a story which has a definite and satisfying end. On the contrary, it is an instrument which the teacher is to use and not a substitute for the teacher, textbooks, maps, drawings, or other time-honored instrumentalities of the classroom; and far from putting an end to the interest of the student, it is designed to provoke questions rather than answer them, and is intended to leave the student at the end of the film with so many insistent questions in his mind and with so much concrete and detailed content that the end of the picture will be, in effect, the beginning of increasingly satisfying effort on his part to interpret his own experiences and answer his own questions.

Films on sixteen millimeter safety stock. No characterization of the films used in this experiment would be complete without observing that they are on non-inflammable safety stock of the sixteen millimeter size film. The machines used in this experiment were the Kodascope Model A projectors. This machine was installed in the various classrooms of the X teachers in twelve cities by representatives of the Eastman Kodak Company, from one to three weeks before the experiment actually started. One of the expert operators of the company met the X teachers in each of the cities and gave them detailed instructions as to the mechanical structure and method of operating the Model A Kodascope. The period of such instruction for each group was perhaps two hours. The company representatives also installed conveniently arranged window shades for darkening the X teachers' classrooms at a moment's notice. In

this connection it is worthy of note that Professors Strayer and Engelhardt have for many years advocated that all classrooms should be provided with electrical outlets and other features designed to facilitate the installation of motion picture projectors.

There are undoubtedly arguments on both sides of the question whether standard size or sixteen millimeter films should be used in the classroom. In our observation of sixteen millimeter films used in classes of 50 or 60 pupils, it appears that all students could see what was taking place on the screen perfectly. At least we got no complaints from any quarter on this score. For all classes of normal size, it seems to us the question of visibility is ruled out of the discussion as to which size is best, and that the smaller cost and convenience of the smaller machine and films definitely favor the smaller size as the more satisfactory for American classroom films.

Distinguishing characteristics of this experiment. While attempting to characterize the films used in this experiment it may not be inappropriate in passing to summarize what might be considered the distinguishing characteristics of this experiment in the field of visual education.

First and foremost is the pedagogical nature of the films described above.

In the second place, the experiment involved enough film material, and continued over a period sufficiently long so that the contribution of the films formed a large enough fraction of the total life experience of the individual for that period to be measurable.

In the third place, these films became an integral and regular part of the curriculum and of the classroom procedure, so that in our comparisons we are concerned with the contributions of a normal classroom and curriculum agency, and not with that of a novelty.

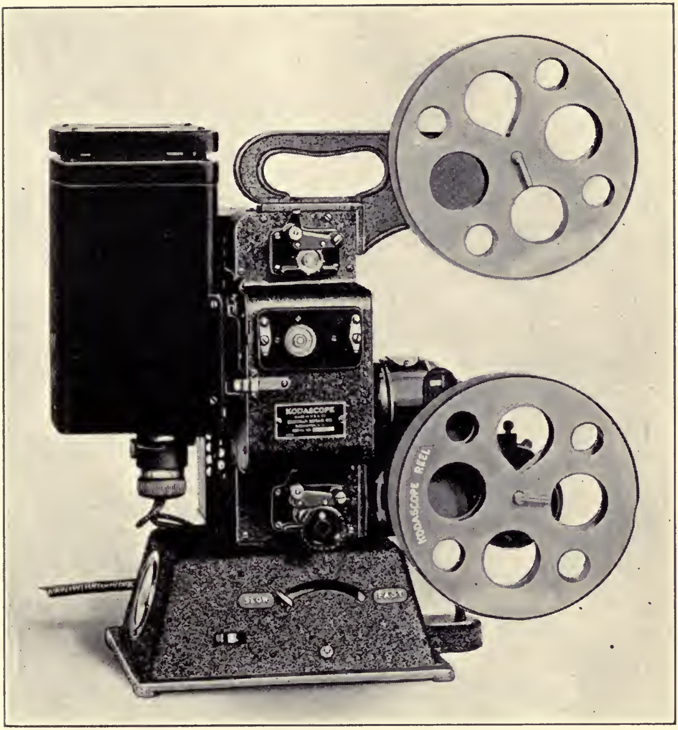

PLATE I. KODASCOPE MODEL USED IN THE EASTMAN TEACHING FILM EXPERIMENT

Projectors of this type were installed in the classrooms of the ninety-three teachers who taught the Experimental classes.

Plate II. Typical Classroom as Equipped for an Experimental Class in the Eastman Teaching Film Experiment

In the fourth place, this experiment involved a very large number of students in the six school grades from the fourth to the ninth inclusive, scattered in a dozen cities, taught by nearly two hundred different teachers in about seventy-five different schools.

It is unnecessary to advert to the fact that previous experiments have involved only about one tenth of the film footage involved in this experiment, and have been mainly concerned with the immediate recall contributions of such single films to relatively small numbers of students. also seems unnecessary to say that the current sporadic use of educational films in the schools is such as to invite a feeling on the part of the students that the film is a special and somewhat extra-curricular adventure in the school auditorium which is not a serious or continuous part of the curriculum, and about which students need not bother their heads when they return to their regular home classrooms.

Time schedule. For the sake of the experiment a uniform time schedule was prescribed for the X and C classes in all cities. This time schedule, as sent to the X and C teachers a week before the experiment started, is given on pp. 40, 41.

This somewhat rigorous schedule was, of course, more than likely to be irritating. Teachers in the X group especially complained about its inflexibility and the inadequacy of the time allowed for the films. The C teachers had no complaints to offer, but some of them suggested that the time allowed was too liberal for many of the topics, especially toward the end of the experiment. In several instances X teachers were sorely vexed and complained rather bitterly about unpedagogical aspects of a predetermined time schedule. This resentment of the X teachers was due more to a misunderstanding of the reason for the insistently enforced time schedule than to any unwillingness to adapt themselves to the exigencies of the experiment. In other

PROGRAM — TIME SCHEDULE

GEOGRAPHY

(1) The schedule below should be observed by the teachers in the EXPERIMENTAL GROUP and by the teachers in the CONTROL GROUP.

(2) If school is closed for a day or more the dates in the remainder of this schedule should be moved forward accordingly. It is suggested in case your school is closed, that you indicate the change of dates for the program in your school by writing the correct dates on this sheet in red ink.

(3) Each group — EXPERIMENTAL and CONTROL — should be given as many lessons or periods of 30 MINUTES EACH AND NO MORE on each topic as the schedule below specifies.

(4) Test papers will be supplied for all tests and these tests should be given in place of the regular recitation on the day specified in the schedule.

TOPICS	DATE
1. *New England Fisheries, Part I Cod.*	
First Period	Feb. 6
Second "	" 7
Third "	" 8
Fourth "	" 9
2. *Wisconsin Dairies*	
First Period	Feb. 10
Second "	" 13
Third "	" 14
TESTS	
a. NEW ENGLAND FISHERIES, PART I — COD	Feb. 15
b. WISCONSIN DAIRIES	" 16
3. *Wheat*	
First Period	Feb. 17
Second "	" 20
Third "	" 21
Fourth "	" 22
4. *From Wheat to Bread*	
First Period	Feb. 23
Second "	" 24
Third "	" 27
Fourth "	" 28
TESTS	
a. WHEAT	Feb. 29
b. FROM WHEAT TO BREAD	Mar. 1
5. *Cattle*	
First Period	Mar. 2
Second "	" 5
Third "	" 6

TOPICS	DATE
6. *Corn*	
First Period	Mar. 7
Second "	" 8
Third "	" 9
Fourth "	" 12
TESTS	
a. CATTLE	Mar. 13
b. CORN	" 14
7. *Cotton Growing*	
First Period	Mar. 15
Second "	" 16
Third "	" 19
8. *Irrigation*	
First Period	Mar. 20
Second "	" 21
Third "	" 22
Fourth "	" 23
Fifth "	" 26
TESTS	
a. COTTON GROWING	Mar. 27
b. IRRIGATION	" 28
9. *Bituminous Coal*	
First Period	Mar. 29
Second "	" 30
Third "	April 2
10. *Iron Ore to Pig Iron*	
First Period	April 3
Second "	" 4
Third "	" 5
Fourth "	" 6
TESTS	
a. BITUMINOUS COAL	April 9
b. IRON ORE TO PIG IRON	" 10

PROGRAM — TIME SCHEDULE

GENERAL SCIENCE

(1) The schedule below should be observed by the teachers in the EXPERIMENTAL GROUP and by the teachers in the CONTROL GROUP.

(2) If school is closed for a day or more the dates in the remainder of this schedule should be moved forward accordingly. It is suggested in case your school is closed, that you indicate the change of dates for the program in your school by writing the correct dates on this sheet in red ink.

(3) Each group — EXPERIMENTAL and CONTROL — should be given as many lessons or periods of 50 MINUTES EACH AND NO MORE on each topic as the schedule below specifies.

(4) Test papers will be supplied for all tests and these tests should be given in place of the regular recitation on the day specified in the schedule.

TOPICS	DATE
11. *Hot Air Heating*	
First Period	Feb. 6
Second "	" 7
Third "	" 8
Fourth "	" 9
12. *Atmospheric Pressure*	
First Period	Feb. 10
Second "	" 13
Third "	" 14
TESTS	
a. HOT AIR HEATING	Feb. 15
b. ATMOSPHERIC PRESSURE	" 16
13. *Compressed Air*	
First Period	Feb. 17
Second "	" 20
Third "	" 21
Fourth "	" 22
14. *The Water Cycle*	
First Period	Feb. 23
Second "	" 24
Third "	" 27
TESTS	
a. COMPRESSED AIR	Feb. 28
b. THE WATER CYCLE	" 29
15. *New York Water Supply*	
First Period	Mar. 1
Second "	" 2
Third "	" 5
16. *Purifying Water*	
First Period	Mar. 6
Second "	" 7
Third "	" 8
TESTS	
a. NEW YORK WATER SUPPLY	Mar. 9
b. PURIFYING WATER	" 12
17. *Limestone and Marble*	
First Period	Mar. 13
Second "	" 14
Third "	" 15
Fourth "	" 16
18. *Sand and Clay*	
First Period	Mar. 19
Second "	" 20
Third "	" 21
Fourth "	" 22
TESTS	
a. LIMESTONE AND MARBLE	Mar. 23
b. SAND AND CLAY	" 26
19. REFORESTATION	
First Period	Mar. 27
Second "	" 28
Third "	" 29
Fourth "	" 30
20. *Planting and Care of Trees*	
First Period	April 2
Second "	" 3
Third "	" 4
TESTS	
a. REFORESTATION	April 5
b. PLANTING AND CARE OF TREES	" 6

words, some of the X teachers apparently assumed that the time schedule was put out as an ideal way in which to use the films, whereas it was an unavoidable compromise or nearly-correct guess at best. The X teachers cannot be praised too much for their self-abnegation in holding to a time schedule which they felt sure was not the best time distribution for the films. It was particularly irritating at the end of the time allotted to a film, to drop that film just at the moment when the children's interests were aroused to the highest pitch and when their projects were only half done, and to plunge into a new topic without exploiting the interest of the children in the preceding one.

Although we were convinced after the first two weeks that the time allotments were not adjusted to bring out the full value of the films, administrative difficulties and the necessity for maintaining equality of the time factor between X and C groups delayed amending the time schedule until the fourth week. On March 2, therefore, about one month after the experiment began, the following amendment was sent out:

AMENDMENT

There is a general criticism in the majority of the centers in which the Classroom Films are being tried out to the effect that sufficient time is not allowed for the presentation of the topic covered by the film. In view of this criticism and the suggestions which have been made, we have decided to suggest to each of the centers that the time devoted to the study of the topics be increased as follows:

Beginning with the films in Geography, give:

Cotton Growing	Four periods instead of three.		
Irrigation	Five	"	as now apportioned.
Bituminous Coal	Four	"	instead of three.
Iron Ore to Pig Iron	Five	"	" " four.

In General Science give:

Purifying Water	Four periods instead of three.

Limestone and Marble	Five periods instead of four.
Sand and Clay	Five " " " " .
Planting and Care of Trees	Four " " " three.
Reforestation	Four " as now apportioned.

This means of course that a similar number of periods must be allowed the control group.

We shall appreciate your further coöperation in the matter if you will be good enough to extend the time on these topics as above suggested.

For two of the twelve cities, one further amendment to the time schedule was made, namely, a two-weeks' review period at the end of the experiment was allowed for both X and C groups. This amendment was made at the urgent request of the X teachers in these two cities, who felt that they had not had sufficient time to bring to fruition the ardent interests which the films had aroused in the children. Many of their students, they declared, were still working on projects which they had started early in the experiment, and it seemed highly inexpedient to them to bring the course of study to a close and resume the regular curriculum of the school system, without letting the children complete their projects. By contrast, the C teachers felt that the time allowance had been too liberal — that the course of study had been somewhat thin, and that their children were becoming bored. However, they acquiesced to the extension of time for the sake of the experiment. This same difference between the feelings of the X and C teachers was manifested in all the cities and is a significant commentary on the curriculum-enriching powers of these classroom films. (See Chapter VIII below.)

The fact that two cities allowed about thirteen weeks and ten cities only eleven or twelve weeks does not vitiate the fundamental comparison with which we are concerned, because there were almost exactly equal numbers of X and C students in each of these two cities, and while the general

average of both X and C groups in these two cities might be raised a little beyond what it would have been, there is no reason to suppose that it would make any difference between the X and C groups, except, perhaps, to increase slightly whatever differences already existed.

SUMMARY

1. The purpose of this experiment was to determine what contributions to the attainment of the usually accepted goals of sound educational practice teaching films might make when used as an integral part of classroom work.
2. The tests were designed to measure not only the clearness and completeness of the child's ideas concerning the objects with which the instruction dealt, but also to measure his ability to generalize and to think.
3. In the experiment the pupils were divided into two groups as nearly equal in age, intelligence, and school achievement as could be secured under the circumstances.
4. One group of pupils was designated as the Experimental or X group and the other as the Control or C group. The only intentional difference between these two groups was that the X group used films in the course of the instruction while the C group did not use films.
5. About 11,000 pupils and nearly 200 teachers participated in the experiment. About 3500 of these pupils were in General Science classes and 7500 in Geography classes.
6. Teachers, as nearly equal in ability and experience as could be determined, were selected by the local school authorities for the X and C groups.
7. The experiment extended over a period of twelve weeks

of instruction and was conducted in twelve cities, widely distributed over the United States.

8. The instruction included ten topics in General Science and ten topics in Geography.
9. A study guide was prepared on each topic for the use of both the X and C groups in order to insure that the area of instruction would be identical for all classes in both groups.
10. The test questions were based strictly upon the areas of instruction delimited by the study guides.
11. Two types of test, one designated as Comprehensive and the other as Topical, were administered.
12. The Comprehensive Tests, objectively scored, included three subtests designated as C1, C2, and C3.
13. Test C1 consisted of one hundred true-false statements and was given only at the beginning of the experiment.
14. Test C2 consisted of one hundred multiple-choice questions and was given both at the beginning and end of the experiment.
15. Test C3 included about one hundred two-answer questions and was given only at the end of the experiment.
16. The Topical Tests were a modified form of the traditional essay examination which is subjectively scored.
17. The Comprehensive and Topical Tests were prepared and scored independently of each other.
18. Teachers of both X and C groups were given identical instructions for the conduct of the work except that a guide, which gave detailed directions as to when to use the film, was provided for the X teachers. These X teachers' guides gave no suggestions relative to the area of instruction which were not also given to the C teachers.
19. The indications and conclusions of this experiment can

be carried over to educational films in general only in so far as such films and their use are similar to those used in this experiment.

20. The classroom films used in this experiment were designed to provoke questions and to aid and stimulate pupils, under the guidance of the teacher, to answer those questions for themselves. The films were constructed on the assumption that it was their function to furnish the teacher with instruction materials which would supplement and enrich the various media of instruction now commonly employed.
21. The films used were on sixteen millimeter safety stock requiring no booth or licensed operator for projection.
22. The experiment itself involved more pupils, more film footage, extended over a longer period of time, and was more nearly national in scope than any investigation in visual education yet attempted.
23. A uniform time schedule was prescribed for X and C classes in all cities. In general the X teachers reported that the time allotted to each topic was too short, while many of the C teachers reported that the time allotted was too long.

CHAPTER II

THE COMPREHENSIVE TESTS

Construction of tests — Administration of tests — Scoring tests and tabulating results — Reliability and validity of tests — Summary.

COMPREHENSIVE INITIAL AND FINAL TESTS

As already noted, there were two types of tests used in this experiment, Comprehensive Objective Tests given at the beginning and end of the experiment, and Topical Written Tests given once every two weeks throughout the course of the experiment. These two series of tests were entirely independent of one another, one series having been constructed, scored, and the results tabulated under the direction of one of the authors in New York City; and the other series having been under the exclusive charge of the other author in Chicago. The purpose and nature of the Topical Tests are described in detail in Chapter V. In the present chapter we shall describe only the Comprehensive Tests.

The reader ought to be warned at once against assuming that these tests, or any other written tests, could adequately measure or even roughly register all of the contributions of the films. A large number of attendant features are embodied in each film that the tests do not reveal, but which afford a body of marginal material that greatly enriches not only the topics treated, but enriches also the incidental experience of the pupil. As illustrations, the way a cod fisherman dresses, the lack of trees on a cattle ranch, the surface features of the Catskills, and other almost innumerable instances of marginal tuition, may be noted. A further limitation of the tests is found in the fact that much of the material in the films was selected because it was thought

that it could be presented more clearly and vividly than expert writers could present it by means of written descriptions, however lengthy. Obviously, any written test would fail to bring out fully those aspects of a topic which were the prime considerations in selecting the subject matter of the film on that topic. Moreover, each film afforded opportunities for the translation of visual impressions into verbal forms of expression that carry a quality of meaning far richer and more integrated than the meanings acquired through verbal impressions alone. It is doubtful if any known technique of testing can reveal adequately this difference. It is probable that in the X groups *visual impressions* were consistently in advance of *facility for expression,* whereas in the C groups, instructed more largely through verbal forms, facility in expression may have tended to outrun the acquisition of meanings based upon experience with reality.

The Initial Tests in General Science and Geography included two hundred objectively scored questions each, of which one half were of the true-false type and the other half of the multiple-choice type. There were ten questions of each type on each of the ten topics in General Science and on each of the ten topics in Geography. Parts 1 and 2 of the Initial Test (C1) contained forty and sixty true-false questions, respectively; and Parts 3 and 4 (C2) contained forty and sixty multiple-choice items, respectively. In both General Science and Geography, the questions of Parts 3 and 4 of the Initial Test (Initial C2) became Parts 1 and 2 of the Final Test (Final C2). Parts 3 and 4 (C3) of the Final Test were made up of two-answer questions in which the students underlined the one of two alternative words or phrases which correctly completed the sentences. The relations between the Initial and Final Comprehensive Tests are clearly indicated in Table 1.

Table 1. Showing the Relations of the Initial to the Final Comprehensive Tests in General Science and Geography, and the Number and Type of Questions in Each Part of the Tests

Initial Test, Parts 3 and 4 include the same identical 100 questions as Final Test, Parts 1 and 2 in both General Science and Geography. Initial Parts 1 and 2 are designated C1, Initial Parts 3 and 4 and Final Parts 1 and 2 are C2, and Final Parts 3 and 4 are C3.

General Science

	True-False Questions C1		Multiple-Choice Questions C2		Two-Answer Questions C3		Total
Initial Test							
Parts	1	2	3	4			
Number of Questions	40	60	40	60			200
Final Test							
Parts			1	2	3	4	
Number of Questions			40	60	37	55	192

Geography

	True-False Questions C1		Multiple-Choice Questions C2		Two-Answer Questions C3		Total
Initial Test							
Parts	1	2	3	4			
Number of Questions	40	60	40	60			200
Final Test							
Parts			1	2	3	4	
Number of Questions			40	60	47	66	213

Construction of tests. The Comprehensive Tests were constructed by the writers and by two or three graduate student assistants who had had considerable training and practice in the construction of objective tests. The tests were based exclusively upon the Study Guides which constituted the syllabi of the courses of study, and which were placed in the hands of the X and C students. The questions in C1 and C2 Tests were constructed without reference to the specific content of the films, are related almost entirely to ideas and concepts such as are ordinarily presented in verbal form, and are largely free from immediate visual reference as may be seen from the reproduction of the tests (Appendices II and III). Test C3 was also based

strictly upon the Study Guides which were in the hands of both X and C groups, but they were constructed with a view to testing information, ideas, and relations which could be derived from readings *and* from the films. The writers of this report, in preparing test C3, were conscious of the possibility of including questions on various specific details in the films, the answers to which were implied in the basic syllabus, but which were not called directly to the attention of the C students either in terms of word pictures or still pictures, and they purposely framed the questions to avoid falling into such error. The test questions in the Appendices (pp. 283–331) are submitted for the careful attention of readers of this report and to enable them to determine for themselves the fairness of the questions to both groups. Objective evidence on this point is presented in Chapter IV, Table 18.

Administration of tests. In view of the magnitude, expense, and importance of this experiment, and in view of the crucial rôle which the tests were to play in the formulation of conclusions as to the future of classroom films, the utmost precautions were taken to guard the tests against misuse or abuse. Special representatives of the writers were appointed in each city to receive, administer, and ship the tests back to us. The tests, counted and sealed, were sent to the responsible examiners, and all copies were accounted for in the return shipment, neither X nor C teachers having anything to do with the receiving, administering, or shipping of the tests. In the preliminary conferences which the writers had with the X and C teachers or supervisors, it was agreed that none of the teachers in either group would look at any of the tests, and all would refrain from taking advantage of any accidental opportunity to see the questions which might arise. The following memorandum covering most of these points was sent on January 23, to the

Plate III. Eighty Thousand Initial and Final Comprehensive Test Booklets Scored and Assembled by the Educational Records Bureau for the Eastman Teaching Film Experiment

Each Part of the Comprehensive Tests was printed in a separate booklet (see Table 1).

supervisor in charge of examiners in each of the twelve cities:

On Saturday, January 21, 1928, we mailed you by parcel post, special delivery, test papers for Geography and General Science.

The following is the program for holding the tests:

Part 1	Thursday	A.M.	February	2, 1928
" 2	"	P.M.	"	2, 1928
" 3	Friday	A.M.	"	3, 1928
" 4	"	P.M.	"	3, 1928

The pupils should be allowed thirty minutes for the work on each part of the test. The thirty minutes should not include the preliminaries at the opening or at the closing of the tests. The time counted should be from the period when the pupils begin work to the period when their work is closed.

It is understood, of course, that none of the teachers who are to participate in the experiment, either those in charge of the Experimental Group or those in charge of the Control Group, are to see these questions.

We shall appreciate your coöperation in this matter if you will see that in each school where the test is conducted the papers submitted are arranged in good order, by classes and schools, and are put in separate packages before they are shipped. The tests may be conducted by the Principal of the school or a member of your supervisory staff.

All test papers not used by the students should be returned. In other words, none of the test papers should be retained by any one in your city.

Scoring tests and tabulating results. As soon as the tests were administered in each center, they were immediately packed and shipped to Rochester where they were counted and checked against class rolls. The papers were then sent to the Educational Records Bureau in New York City where they were scored and checked under the immediate supervision of one of the writers. All the tabulating and statistical work has been done by the statistical staff of the Educational Records Bureau under the immediate direction of one of the authors.

Reliability and validity of tests. Readers who are familiar with the literature on objective tests will be able to secure a fairly satisfactory notion of the reliability and validity of the objective tests used in this experiment by inspecting the questions reproduced in the Appendices, pp. 283–331. We therefore present only a minimum of statistical evidence on these points.

TABLE 2. SHOWING RELIABILITY COEFFICIENTS OF THE GENERAL SCIENCE AND GEOGRAPHY COMPREHENSIVE TESTS, BASED ON RESULTS FROM X AND C GROUPS IN TWO CITIES

GENERAL SCIENCE

CITY A — CONTROL

	$r_{\frac{1}{2}\frac{1}{2}}$	Spearman Brown r_{11}	Sigma Evens	Sigma Odds	No. of Cases	No. of Questions
Initial (C1 + C2) Total	.623	.770 ± .019	10.14	11.1	207	200
Final (C2 + C3) Total	.671	.804 ± .017	7.10	7.9	187	200
Initial C2	.577	.723	5.20	5.12	214	100
Final C2	.561	.718	4.80	5.29	187	100

GEOGRAPHY

CITY I — EXPERIMENTAL

Initial (C1 + C2) Total	.548	.708 ± .034	9.5	10.2	102	200
Final (C2 + C3) Total	.889	.941 ± .008	10.0	11.0	95	200
Initial C2	.651	.789	4.86	5.4	102	100
Final C2	.684	.752	6.24	5.82	95	100

Table 2 shows the split-test reliability coefficients and Spearman-Brown estimates of whole-test reliability coefficients for the total Initial and Final Comprehensive Tests and for Initial and Final Tests C2 in General Science and in Geography. These coefficients seem satisfactorily high. The Spearman-Brown whole-test reliability for the total Initial General Science Test is 0.770, ±.019; and for the total Final General Science Test 0.804, ±.017. Corresponding

coefficients for C2 Initial and Final Tests in General Science are 0.723 and 0.718. The Spearman-Brown coefficients for Geography Tests are on the whole somewhat higher than for the General Science Tests. The total Initial Test in Geography has a Spearman-Brown reliability of 0.708, ±.034, and the total Final Test, 0.941, ±.008. The corresponding coefficients for C2 Initial and Final Tests in Geography are .789 and .752, respectively.

The reliability coefficients of C2 Initial and Final Tests are satisfactorily high for our purposes. It will be recalled that these two tests include the same identical one hundred multiple-choice questions. Since the comparative gains of the X and C groups are based upon their initial and final responses to these one hundred questions, it will be well to keep in mind that the reliability in General Science is about 0.72 and in Geography between 0.75 and 0.79, the probable errors in all cases being satisfactorily small. Such reliability coefficients seem entirely adequate for the group comparisons with which we are concerned in this study.

No satisfactory means for measuring the validity of our tests seems available. As an indirect measure we have calculated some intercorrelations between the parts and the wholes of the Initial and Final Tests. These coefficients are presented in Table 3.

In Table 3 we have used two samplings for each set of scores, each sampling including all the students that took the tests in one city. Cities A and I were chosen for the General Science Test and Cities B and I for the Geography. In general there is remarkable agreement between the results of the two samplings and between the results for the X and C groups in each city. The general average of all these intercorrelations is in the neighborhood of .60, the only noticeable deviation being in the correlations for City I between Initial C2 and Initial C1 in both General Science

TABLE 3. SHOWING INTERCORRELATIONS OF THE TOTAL INITIAL AND TOTAL FINAL TESTS, AND OF THEIR PARTS, BASED ON ALL X AND C CASES IN CITIES A AND I FOR GENERAL SCIENCE, AND ON ALL CASES IN CITIES B AND I FOR GEOGRAPHY

GENERAL SCIENCE

Tests Correlated			City I				City A			
I	II		r	Sigma I	Sigma II	N	r	Sigma I	Sigma II	N
Init. Tot. with Fin. Tot.		X	.54	14.37	15.93	126	.71	17.61	14.33	126
		C	.58	15.02	13.23	77	.66	20.11	13.86	187
Init. C2 with C1		X	.326	6.53	6.76	133	.543	6.86	11.22	141
		C	.440	7.08	8.25	77	.572	8.84	12.81	208
Init. C2 with Fin. C2		X	.57	6.53	9.32	133	.557	6.86	9.40	141
		C	.697	7.08	7.22	77	.608	8.84	8.92	208
Fin. C2 with C3		X	.536	9.30	8.44	126	.652	9.27	6.70	124
		C	.637	9.35	6.10	77	.64	9.04	6.45	187

GEOGRAPHY

Tests Correlated			City B				City I			
I	II		r	Sigma I	Sigma II	N	r	Sigma I	Sigma II	N
Init. Tot. with Fin. Tot.		X	.634	20.13	24.49	207	.506	16.39	20.26	95
		C	.582	20.88	20.62	187	.650	15.10	12.96	98
Init. C2 with C1		X	.590	10.00	11.10	221	.315	8.45	11.40	103
		C	.637	10.37	12.00	195	.331	8.21	11.26	101
Init. C2 with Fin. C2		X	.607	10.00	10.10	221	.654	8.45	11.81	103
		C	.62	10.37	10.78	195	.586	8.21	7.22	101
Fin. C2 with C3		X	.81	11.30	14.85	207	.761	11.25	10.34	95
		C	.785	10.72	11.86	187	.590	5.21	8.69	98

and Geography. These correlations are very low, averaging about .30. The reason for this seems to be the very low average score achieved by the children in this city on the Initial Tests, resulting in small variability in their scores.

Table 4 shows, in three cases at least, that the small magnitude of the City I coefficients is due to the very small standard deviation of the scores. However, the correction for variability in the Geography Tests fails to raise the magnitude of the coefficients to any appreciable extent, thus

showing that there was some vitiation or irregularity in the City I Geography classes. We have no means of tracing the nature or cause of this irregularity. We only know that in

TABLE 4. SHOWING EFFECT OF VARIABILITY ON THE CORRELATIONS OF TABLE 3

GENERAL SCIENCE — EXPERIMENTAL

	City I		City A	
	Sigmas	r	Sigmas	r
Test C1	6.7561	.326	11.2216	.543
Initial Test C2	6.5309		6.8555	

r for City I if variability were the same as in A = .519

GENERAL SCIENCE — CONTROL

	City I		City A	
	Sigmas	r	Sigmas	r
Test C1	7.0829	.293	12.8130	.572
Initial Test C2	8.2480		8.8298	

r when City I variability is same as in A = .5104

GEOGRAPHY — EXPERIMENTAL

	City I		City B	
	Sigmas	r	Sigmas	r
Test C1	11.4021	.266	11.0793	.581
Initial Test C2	8.4530		9.9972	

r when City I variability is same as in B = .3021

GEOGRAPHY — CONTROL

	City I		City B	
	Sigmas	r	Sigmas	r
Test C1	11.2614	.310	12.0009	.637
Initial Test C2	8.2094		10.3650	

r when City I variability is same as in B = .380

City I all of the Geography C students are in the Sixth Grade and that 67 of the 104 X students are in the Fourth or Fifth Grades. City I is the only city in which the X and C classes were not matched by school grade. Needless to say, this was not discovered by the investigators until it was too late to correct the disparity.

Table 5 furnishes additional indirect evidence on the validity of the General Science and Geography Tests. It

TABLE 5. SHOWING THE CORRELATIONS OF INTELLIGENCE MEASURES WITH GENERAL SCIENCE AND GEOGRAPHY FINAL TESTS BASED ON RESULTS FROM CITIES A AND I

GENERAL SCIENCE — CITY A

	r	P.E.$_r$	Sigma Intell.	Sigma Test	N
X Final C2	.481	±.038	13.45	9.37	141
X Final Total	.481	±.047	14.00	14.35	124
C Final C2	.281	±.044	10.72	8.88	197
C Final Total	.300	±.047	11.30	13.70	177

GEOGRAPHY — CITY I

	r	P.E.$_r$	Sigma Intell.	Sigma Test	N
X Final C2	.405	±.056	14.50	11.90	96
X Final Total	.385	±.061	14.20	18.80	88
C Final C2	.173	±.068	16.80	7.90	93
C Final Total	.223	±.046	14.30	14.00	90

will be noticed that the correlations between intelligence measures and the General Science and Geography Tests are uniformly about twice as large for the X as for the C groups in Cities A and I. The interpretation of this difference is somewhat difficult, but it is certainly not far-fetched to suggest that the films may have stimulated children to approximate, in their achievement, what they were intel-

lectually capable of doing, whereas in the C groups achievement was more related to momentary interests than to native ability to achieve.

SUMMARY

1. No written test could measure all the contributions of the films. Marginal impressions, not revealed by tests, enrich the topic treated, and enrich also the incidental experience of the pupil.
2. Tests C1 and C2 were constructed without reference to the specific content of the films, but were based solely upon the contents of the study guides.
3. Test C3 was also based strictly upon the contents of the study guides, but included only such questions as could be answered from data found in readings and also from data presented in the films.
4. All tests were administered by representatives of the directors of the experiment. The teachers were not to see the tests, nor did they have anything to do with administering or scoring them.
5. The Spearman-Brown reliability coefficients are high enough to be entirely adequate for all group comparisons made in this report.

CHAPTER III

INITIAL COMPARISON OF EXPERIMENTAL AND CONTROL GROUPS

PUPILS: Age, intelligence, and initial achievement: A. General Science; B. Geography — Educational maturity — Sex constitution — Size of X and C classes — TEACHERS: Rivalry between X and C teachers — Over-reliance on films — Practice tests used by C teachers — Summary.

IN an ideal experiment, as indicated in the first chapter, the X and C groups would be equal in all significant respects, save only for the single difference that the X group would have the benefit of the films. The coöperating school authorities appreciated the importance of approximating this ideal as closely as possible and did all that they could to parallel each X class with a C class of the same sex, age, and grade constitution, of the same general ability and sociological background, having an equally competent teacher and enjoying equally favorable library facilities, classroom equipment, and learning conditions. As was fully expected, administrative exigencies prevented a strict fulfillment of this ideal in most of the cities, and the authorities, fortunately for the experiment, tended to favor the C rather than the X groups, whenever differences were unavoidable. Obviously, it would be fruitless to compare the progress of X and C groups without taking careful account of any handicaps which either group may have suffered.

PUPILS

Age, intelligence, and initial achievement

A. General Science. Table 6 summarizes data on the chronological age, intelligence, and general achievement in General Science of the X and C groups in each of the twelve

cities, and in all of the twelve cities taken together. The data on chronological age and intelligence were furnished by the coöperating schools, while the data on achievement in General Science were derived from the General Science Initial Test which was administered as the first step in the experiment. At this point we need only repeat that the Initial Test consisted of two hundred objectively scored questions — one hundred true-false and one hundred multiple-choice items, equally distributed between the ten General Science topics.

Table 6 is to be read as follows: In City A there were 164 students in the X classes in General Science and 231 in the C classes. The median chronological age of the X students was 14.2 years and of the C students 13.9 years. The average intelligence score of X students was 101.0 and of the C students 111.4, thus showing a significant difference in favor of the C students in City A. The next column, headed "Intelligence Sigmas," shows the standard deviation of the intelligence scores of the X students to be 13.7 and of the C students to be 12.4. Taking either of these measures of variability as a unit, the difference of over ten points between the intelligence score medians of the X and C groups indicates that at least 75 per cent of the C students in City A are above the average of the X students. This is a large and significant handicap which is amply confirmed by the total Initial Test medians in the last column for City A. According to the 200-question Initial Test in General Science, the X group secures a median score of 55.5 and the C group a median score of 74.5, a difference of 19 points in favor of the C group. When we compare this 19 point difference with the standard deviation of the scores of 3300 X and C students that took the General Science Test, which according to the last figure in the last column of Table 6 is 21.77, we find that the C median is almost a whole standard

Table 6. Showing for General Science X and C Groups in Each City:

(*a*) the number of students that took the total Initial Test; (*b*) chronological age medians of all students enrolled in the X and C classes; (*c*) means and sigmas of intelligence test measures of all children in X and C groups for whom such measures were available (95 to 98 per cent of cases in column 1); and (*d*) median scores of X and C groups on total Initial Test in General Science.

Cities	No. of Cases	Chron. Age Medians	Intell. Means	Intell. Sigmas	Total Initial Test Medians
A	X 164	14.2	101.0	13.7	55.5
	C 231	13.9	111.4	12.1	74.5
B	X 83	13.5	99.2	11.7	50.6
	C 90	13.7	98.4	14.0	54.0
C	X 254	13.6	111.6	14.7	76.2
	C 286	13.6	108.0	26.4	63.1
D	X 259	12.6	100.0	7.0	51.1
	C 211	13.3	105.0	5.0	53.1
E	X 143	14.3	109.2	30.0	67.3
	C 139	14.2	119.3	31.5	85.0
F	X 165	14.7	98.2	11.9	63.3
	C 179	14.3	105.4	15.9	70.6
G	X 130	15.0	105.9	16.8	65.9
	C 143	14.7	106.6	15.2	58.9
H	X 37	12.1	130.4	7.3	44.6
	C 42	12.6			41.7
I	X 173	14.0	90.9	12.4	45.1
	C 90	13.9	92.6	14.2	43.6
J	X 140	12.8	114.0	8.9	64.5
	C 154	12.9	114.5	9.9	60.0
K	X 32	14.6	107.7	14.2	79.0
	C 28	14.4	110.3	10.8	80.0
L	X 49	14.8	95.9	10.1	70.0
	C 50	14.3	101.9	12.7	63.6

All cities	X 1629	Q3	14.6	All cities, medians	X	59.9
		Md	13.7		C	63.1
		Q1	12.9	All cities, means	X	59.56
					C	62.37
	C 1643	Q3	14.6		X + C	60.97
		Md	13.8	All cities, sigmas	X	21.45
		Q1	13.1		C	22.00
					X + C	21.77

$$\frac{M_x - M_c}{S.D._{x+c}} = \frac{-2.81}{21.77} = -12\% \text{ S.D.}$$

deviation above the X median. In other words, this means that at least 80 per cent of the C students in General Science in City A are above the average of the X students, and that the X group is starting the experiment with an even larger handicap in General Science achievement than in average intelligence or scholastic ability.

A similar reading of the rows of figures for each of the other 11 cities will show (1) that the X and C classes are almost exactly equal as to chronological age, (2) that in intelligence the X students are below the average of the C students in 9 out of 11 cities for which we had comparative data, and (3) that in General Science achievement, the X classes are below the C classes in 6 of the cities and slightly above in 6 of the cities. When we consider the children from all cities as one group, we find that the X group has an average achievement score about 3 points below the average score of the C group. Thus, the C group begins the experiment with an average in General Science achievement test scores which is above the X average to the extent of 12.0 per cent of the standard deviation of the X and C groups taken together.

Since the schools in different cities used different intelligence tests and did not furnish us with exact information on what tests they used, we find it inexpedient to try to merge the intelligence measures from all of the cities into one distribution. We have made only one assumption in interpreting the intelligence data, namely, that except where otherwise noted, the intelligence scores reported for a given city are comparable for the X and C groups. It has been difficult in several cases to know whether the intelligence measures reported are I.Q.'s or test scores, but we have assumed the unit would be the same for the X and C groups for a given city except where evidence to the contrary was observed. We may arrive at a rough total measure of the

relative intelligence averages for the whole X and C groups by expressing the difference for each city in terms of the average standard deviation for each respective city, and by taking the algebraic sums of these differences and dividing by 11 (since City H is out of the comparison). The average superiority of the C group thus turns out to be about 0.2 S.D., or 20 per cent of the standard deviation.

B. Geography. Table 7 is read in the same way as Table 6, and shows the relative standing as to chronological age, intelligence, and initial achievement in Geography of the 3400 X and 3200 C students that took part in the experiment. In eight of the twelve cities the X students have a lower average intelligence score than the C students, and in nine of the twelve cities the X students have average scores on the total Initial Test in Geography lower than the average scores of the C students. Taking all the children from all the cities in one group, we find that the X and C groups are almost exactly equal in Geography achievement at the beginning of the experiment. The X students score 51.9 and the C 52.5, a difference of only six tenths of a point in favor of the C group. Using the mean score instead of the median, we find that the difference in favor of the C group is 51.8 − 51.03 or 0.77 score points. Since the standard deviation is something over twenty points, this slight difference in favor of the C group seems negligible. The differences in average intelligence scores are somewhat greater than the differences in initial achievement in Geography, but not so great as the intelligence score differences between the X and C students in General Science, as shown in Table 6. This point should be remembered in connection with Chapters IV, VI, and VII where we find that the superiority of X over C students in Geography is greater than the superiority of X over C students in General Science. The suggestion emerging here is that if the General Science X and C classes had been

TABLE 7. SHOWING FOR GEOGRAPHY X AND C GROUPS IN EACH CITY:

(*a*) the number of students that took the total Initial Test; (*b*) chronological age medians of all students enrolled in the X and C classes; (*c*) means and sigmas of intelligence test measures of all children in X and C groups for whom such measures were available (95 to 98 per cent of cases in column 1); and (*d*) median scores of X and C groups on total Initial Test in Geography.

Cities	No. of Cases	Chron. Age Medians	Intell. Means	Intell. Sigmas	Total Initial Test Medians
A	X 464	11.9	100.5	18.6	49.4
	C 438	11.7	103.8	17.3	49.8
B	X 266	12.3	96.8	16.6	56.3
	C 233	12.7	99.2	18.7	56.4
C	X 333	11.0	95.4	17.3	61.3
			11 yr. 6 mos.	15.56 mo.	
	C 327	11.2	12 yr. 4 mos.	15.8 mo.	63.8
D	X 291	11.8	100.5	12.35	47.2
	C 224	11.9	99.0	10.00	47.2
E	X 452	10.2	107.1	13.6	57.1
	C 424	10.2	111.6	11.9	59.0
F	X 278	11.3	106.9	14.9	60.0
	C 203	10.8	109.4	15.6	60.9
G	X 281	11.1	112.5	16.3	59.1
	C 266	11.2	110.3	17.1	63.3
H	X 96	11.0	103.5	17.8	41.8
	C 130	10.7	107.2	17.9	40.7
I	X 124	10.7	107.5	14.5	49.5
	C 114	11.6	110.5	14.0	60.3
J	X 176	10.9	98..	16.7	45.0
	C 193	10.6	100.2	16.5	42.8
K	X 106	10.8	107.6	18.7	43.0
	C 102	11.3	98.1	16.0	44.3
L	X 565	11.4	100.5	18.4	43.0
	C 528	11.9	95.0	17.4	44.3

All cities	X 3432 Q3	12.3	All cities, medians	X	51.9
	Md	11.3		C	52.5
	Q1	10.5	All cities, means	X	51.03
				C	51.80
	C 3182 Q3	12.2		X+C	51.40
	Md	11.3	All cities, sigmas	X	20.21
	Q1	10.5		C	20.71
				X+C	20.45

$$\frac{M_x - M_c}{S.D._{x+c}} = \frac{-0.77}{20.45} = -3.7\% \text{ S.D.}$$

as nearly equal as the Geography X and C groups, the General Science differences in favor of the X groups might have been somewhat more nearly equal to the differences in favor of the X groups in Geography.

Educational maturity. Table 8 shows the relative educational maturity of the X and C groups in terms of grade placement. Of the 1631 students in General Science in the X classes, 38.2 are in the Seventh Grade, while only 30.6 per

TABLE 8. SHOWING THE PROPORTIONS OF THE X AND OF THE C GROUPS THAT ARE IN EACH SCHOOL GRADE

All students from the twelve cities who took the total Initial Test are included in this table.

GENERAL SCIENCE

Per cents of X and C groups in each school grade

Total Number All Grades	Seventh Grade	Eighth Grade	Ninth Grade
X 1631	38.2	41.8	20.0
C 1634	30.6	48.0	21.4

GEOGRAPHY

Per cents of X and C groups in each school grade

Total Number All Grades	Fourth Grade	Fifth Grade	Sixth Grade
X 3360	6.6	48.5	44.9
C 3182	8.7	42.5	48.8

cent of the 1634 C students are in the Seventh Grade. There is also a slight, possibly negligible, difference in favor of the General Science C group in the Ninth Grade. In Geography there seems to be a slight advantage in favor of the C group, since 48.8 per cent of the C and only 44.9 per cent of the X students are in the Sixth Grade. However, this advantage is very slight or negligible.

Table 9 presents in slightly different form the same facts

as Table 8. Of all the Seventh Grade students in General Science who took part in the experiment, 55.5 per cent are in the X classes and 44.5 per cent are in the C classes. This constitutes a noticeable advantage for the C group. In Geography the same percentages hold but in reverse order, indicating that the advantage lies with the X group.

TABLE 9. SHOWING THE PROPORTIONS OF STUDENTS IN EACH SCHOOL GRADE THAT ARE IN THE X AND C GROUPS

This is an elaboration of Table 8 confirming the indications in Table 8 that the X group in General Science, as a whole, is slightly handicapped in respect to general educational maturity, and that in Geography the X group suffers only a negligible handicap as to school grade, if any at all.

GENERAL SCIENCE

	Seventh Grade		Eighth Grade		Ninth Grade	
	Number	Per cent	Number	Per cent	Number	Per cent
X	623	55.5	681	46.5	327	48.3
C	499	44.5	785	53.5	350	51.7
Totals	1122	100.0	1466	100.0	677	100.0

GEOGRAPHY

	Fourth Grade		Fifth Grade		Sixth Grade	
	Number	Per cent	Number	Per cent	Number	Per cent
X	223	44.6	1628	54.6	1509	49.3
C	277	55.4	1352	45.4	1553	50.7
Totals	500	100.0	2980	100.0	3062	100.0

Sex constitution. Table 10 shows the sex constitution of the X and C groups. The only significant difference appears to be in General Science, where 52 per cent of the X and only 46.6 per cent of the C students are girls. Since the girls seem to gain somewhat less than the boys in General Science, this preponderance of girls in General Science may be mentioned as another advantage in favor of the C group. As we shall see below in Table 20, the sex differences are not

great, but in so far as they operate they favor the C groups in General Science.

TABLE 10. SHOWING NUMBERS AND PER CENTS OF BOYS AND OF GIRLS IN X AND C GROUPS IN ALL CITIES

All students who took the total Initial Tests are included.

GENERAL SCIENCE

	Numbers			Per cents	
	Boys	Girls	Total	Boys	Girls
X	782	849	1631	48.0	52.0
C	872	762	1634	53.4	46.6

GEOGRAPHY

	Numbers			Per cents	
	Boys	Girls	Total	Boys	Girls
X	1667	1693	3360	49.6	50.4
C	1546	1636	3182	48.6	51.4

Size of X and C classes. In order to account for as many factors as came to our observation, we have made distributions of the sizes of the classes in the X and C groups. Table 11 shows the medians and quartiles of these distributions. There is no difference between the X and C groups in Geography, and only a slight or negligible difference in General Science. The difference is so small as to be negligible, but if it did operate at all, it was in favor of the X groups, since the C classes averaged about three students per class more than the X classes.

TABLE 11. SHOWING RELATIVE SIZES OF X AND C CLASSES

	General Science			Geography	
	X	C		X	C
Q3	37.2	40.5	Q3	41.1	40.0
Md.	32.7	35.2	Md.	37.3	37.3
Q1	28.6	29.5	Q1	31.7	31.7

TEACHERS

Table 12 shows the number of classes taught by men and the number of classes taught by women in the X and C groups. There were only three classes in Geography taught by men and two of these were in the X group. In General Science 41 classes were taught by men and 68 classes were taught by women. These men and women teachers were so distributed among the X and C classes as to give a preponderance of men teachers to the X classes and a preponderance of women teachers to the C classes. We have no evidence as to whether this difference gave any advantage to one side or the other.

TABLE 12. SHOWING NUMBERS OF CLASSES TAUGHT BY MEN AND BY WOMEN IN X AND C GROUPS IN GENERAL SCIENCE AND GEOGRAPHY

	General Science			Geography			
	Men	Women	Total	Men	Women	Total	Grand Totals
X	27	29	56	2	101	103	159
C	14	39	53	1	94	95	148
Totals	41	68	109	3	195	198	307

Table 13 shows the number of men and women teachers in the X and C groups in General Science and in Geography.

TABLE 13. SHOWING NUMBERS OF MEN AND OF WOMEN TEACHERS WHO INSTRUCTED THE X AND C CLASSES IN GENERAL SCIENCE AND GEOGRAPHY

	General Science			Geography			
	Men	Women	Total	Men	Women	Total	Grand Totals
X	11	12	23	1	69	70	93
C	7	18	25	1	65	66	91
Totals	18	30	48	2	134	136	184

We have no data on the relative ability or teaching experience of the X and C teachers. The school authorities

of each of the cities understood the importance of providing equal teaching ability in the X and C groups, along with equality of student personnel as to age, intelligence, maturity, sociological background, and specific achievement in General Science and in Geography. We have, however, statements of some of the school officers in several cities and our own observations. We can say with considerable confidence that the X teachers as a group were certainly not superior to the C teachers. We saw excellent teaching and poor teaching in both groups, which was entirely expected; in fact, it was a part of the original plan of the experiment to try out the films with average groups of teachers and not with a few selected teachers only. The reason for this is obvious, namely, that we wished to determine the contribution that films make to the schools as they are, and not merely to schools or classes whose teachers are in the upper ten or fifteen per cent of teaching ability.

There were two or three other factors which we think worthy of mention in comparing the learning conditions of the X and C groups.

Rivalry between X and C teachers. The first of these factors was the keen feeling of rivalry that developed among the C teachers. They had been requested to avoid any abnormality in their classroom management such as might be produced by an excessive sense of rivalry, but this injunction was almost universally unheeded. With the C teachers this rivalry took the form of urging the children to unwonted activity in visiting local industries, in library work, in the collection of pictures, maps and charts, in the working out of projects, and in the preparation of various kinds of exhibits.

Over-reliance on films. Over against this excessive energy displayed by the C teachers we set the fact that some of the X teachers tended to lean on the films too heavily.

This appeared to be especially the case in several General Science classes. We got this impression not only from direct observation of classroom work, but also from the detailed reports which the X and C teachers submitted at the end of each topic. (See Chapters VIII and IX.) It seems clear that at least two or three of the X General Science teachers labored under the misapprehension that they were to avoid the use of their regular teaching devices, such as assigned readings, projects, lantern slides, charts, maps, diagrams, and still pictures, and were to depend exclusively on the films and classroom discussion of the films. Every precaution was taken by the directors of the experiment to prevent any such misconception. In nearly all our conferences and communications great emphasis was put upon the fact that the films were additions to the pedagogical devices already used and not substitutes for them. In spite of this, some of the General Science X teachers seemed to think it would be unfair to the experiment to use their usual pedagogical devices along with the films (Chapter VIII). This inequality was restricted largely to the General Science classes, but was present to some extent in the Geography classes also.

Practice tests used by C teachers. We have already referred to the wide-spread use of lantern slides, maps, charts, posters and projects on the part of the C teachers. The final difference which we observed in the conduct of the X and C classes and one which was amply confirmed by an analysis of the written reports which the teachers submitted at the end of each topic, was that the C teachers used objective tests much more extensively than the X teachers throughout the whole period of the experiment. The use of such tests by the C teachers undoubtedly gave their students considerable practice which was turned to account in taking the final tests.

SUMMARY

1. The general indication of this chapter is that the X group started the experiment with several handicaps.
2. The average intelligence score of the X group was inferior to that of the C group to the extent of 20 per cent of a standard deviation in General Science classes and to the extent of about 10 per cent in Geography classes.
3. Slightly larger proportions of the X groups than of the C groups were in lower school grades, especially in General Science.
4. The proportion of girls was greater in the X than in the C group in General Science. Since the girls gained less than the boys (Table 20) this probably constitutes a handicap for the X group in General Science.
5. The X and C classes were approximately the same size in both General Science and Geography.
6. The available evidence indicates that the X teachers were not superior to the C teachers. The necessity of adjusting their teaching to an unfamiliar mechanism may have constituted a slight handicap for the X teachers.
7. There is abundant evidence that the C teachers exerted themselves throughout the whole experiment to overcome the advantage which they supposed the films gave to the X teachers.
8. A few of the X teachers, especially in General Science, leaned too heavily upon the films and thus handicapped their classes.
9. Many C teachers gave their students extensive practice with the types of tests used in this investigation. Only a negligible number of the X teachers gave their students the advantage of such practice.

CHAPTER IV

FINAL COMPARISON OF EXPERIMENTAL AND CONTROL GROUPS ON THE COMPREHENSIVE TESTS

Relative Gains of Experimental and Control Groups: General Science — Geography — Final Test Average Scores of Experimental and Control Groups: Average scores on Final Tests C3 — Average scores on total Final Tests (C2 + C3) — Impartiality of C3 Tests — Variability of Scores of Experimental and Control Groups — A Miniature Experiment — Gains Analyzed by Sex and School Grade — Probable Errors of Difference between Experimental and Control Groups — Summary.

RELATIVE GAINS OF EXPERIMENTAL AND CONTROL GROUPS

The data presented on X and C children in Chapter III related to all of the children who were in the classes at the beginning of the experiment. The comparisons of gains between X and C children will necessarily be confined strictly to those who took Initial Test C2 and Final Test C2. For example, Table 6 above shows that in City A there were 164 X students and 231 C students in General Science who took the total Initial Test. Table 14 shows that 144 X and 207 C students in City A took Final Test C2 in General Science. Similar losses occurred in all the other cities as may be seen by a detailed comparison of Tables 14 and 15 with Tables 6 and 7. These losses were almost certainly due to chance factors, such as illness or exigencies in the homes of the children, so that no pronounced selective force was operative. Nevertheless, we deemed it advisable to make new distributions of the intelligence scores of the X and C children who took the Initial Test C2 and Final Test C2. Since chronological age is probably not highly significant for our purposes, we made no new distributions but accepted

the median chronological ages of Tables 6 and 7 for Tables 14 and 15.

General Science. Table 14 is parallel to Table 6 and shows the relative gains in General Science of the X and C groups for each city separately, and for all cities together.

In eight of the twelve cities the average intelligence score of the X students is below that of the C students. This comparison is based upon the intelligence measures of all students who took Initial and Final Test C2, and who had intelligence measures reported for them by the schools. Practically all of the students involved in the initial and final test comparison had intelligence measures reported for them; that is, between 95 and 97 per cent.

Table 14 shows the intelligence difference in terms of the standard deviation of the intelligence measures of the X and C classes in each city taken as one group. In City A, for example, the average intelligence score of the X group is about three quarters of the standard deviation below the average of the C group. In City D the C group average is about one half the standard deviation below the X group average. Taking an unweighted average of these differences, expressed in terms of standard deviation, we find that the 1340 X students are, roughly speaking, about one fifth of the common standard deviation below the 1346 C students as to average intelligence test score.

The last column of Table 14 shows the differences between the X and C gains. In eight of the twelve cities the X students gained more than the C students. Taking all cities together the median gain of the X students is 18.3 and of the C students 16.8, showing a difference in favor of the X students of 1.5 score points. In terms of arithmetical means, the X group gained 16.83 and the C group gained 15.07, showing a difference of 1.76 score points in favor of the X group. This difference is considered significant because

Table 14. Showing for All X and C Students who Took Initial C2 Tests and Final C2 Tests:

Medians of chronological ages, Intelligence test means and S.D.'s, differences between X and C intelligence means expressed as fractions of the sigmas of X + C intelligence measures, Initial and Final General Science Test medians, median gains of X and C groups, and the difference between the gains of X and C groups.

General Science

Cities	No. of Cases	Median C.A.	Intell. Means	Intell. S.D.'s	Intell. $\frac{M_x - M_c}{S.D._{x+c}}$	Init. C2 Medians	Final C2 Medians	Gain	X Gains minus C Gains (in terms of score points)
A	X 144	14.2	101.65	13.70		43.5	63.7	20.2	
	C 207	13.9	112.13	11.85		48.9	68.1	19.2	
	X+C 351		107.68	13.68	−.766				+1.00
B	X 71	13.5	98.63	12.35		39.1	57.8	18.7	
	C 79	13.7	97.88	13.80		41.3	59.6	18.3	
	X+C 150		98.24	13.14	.057				+0.50
C	X 235	13.6	112.84	14.10		48.5	69.6	21.1	
	C 242	13.6	107.28	25.35		44.6	60.6	16.0	
	X+C 477		109.44	21.00	.265				+5.10
D	X 212	12.6	108.60	8.55		37.4	51.8	14.4	
	C 169	13.3	104.20	8.40		40.8	52.4	11.6	
	X+C 381		106.71	8.62	.512				+2.80
E	X 124	14.3	109.15	30.10		46.0	57.8	11.8	
	C 125	14.2	119.18	31.40		54.0	67.5	13.5	
	X+C 249		114.06	31.16	−.322				−1.70
F	X 157	14.7	98.80	11.65		46.0	67.1	21.1	
	C 157	14.3	106.06	16.40		47.5	60.5	13.0	
	X+C 314		102.30	14.61	−.497				+8.10
G	X 36	15.0	104.83	17.35		51.1	67.9	16.8	
	C 50	14.7	105.2	17.80		45.7	57.0	11.3	
	X+C 86		105.06	17.64	−.021				+5.50
H	X 35	12.1	130.78	7.35		34.6	60.2	25.6	
	C 31	12.6				35.2	65.4	30.2	
	X+C 66								−4.60
I	X 134	14.0	92.04	11.80		33.1	42.8	9.7	
	C 78	13.9	92.8	14.45		35.7	44.0	8.3	
	X+C 212		92.29	12.70	−.060				+1.40
J	X 125	12.8	114.34	8.40		48.2	66.1	17.9	
	C 137	12.9	114.61	15.60		46.3	64.4	18.1	
	X+C 262		114.48	12.66	−.021				−0.20
K	X 31	14.6	106.39	14.50		52.5	65.0	12.5	
	C 26	14.4	110.21	11.10		52.5	67.0	14.5	
	X+C 57		108.19	13.14	−.291				−2.00
L	X 36	14.8	94.71	9.95		40.7	61.3	20.6	
	C 45	14.3	102.99	13.40		42.3	61.1	18.8	
	X+C 81		99.24	12.64	−.655				+1.80
All cities, medians	X 1340					42.8	61.1	18.3	
	C 1346		Intell. Average			44.7	61.5	16.8	+1.50
	X+C 2686				−.2 sigma				
All cities means	X 1340					43.32	60.18	16.83	
	C 1346					45.52	60.59	15.07	
	X+C 2686					44.42	60.39	15.97	+1.76
All cities	X 1340					10.15	12.55		
	C 1346					10.05	11.60		
	X+C 2686					10.16	12.08		

$$\frac{G_x - G_c}{S.D._{x+c}} = \frac{1.76}{12.08} = 14.5\% \text{ S.D. Scores}$$

$$\frac{G_x - G_c}{G_{x+c}} = \frac{1.76}{15.97} = 11.0\% \text{ Mean Gain}$$

it is about 14 per cent of the standard deviation of Final C2 Test scores, and because it is more than ten per cent of the mean gain of both film and non-film students; and especially because the non-film students were measurably superior to the film students both in intelligence and in initial achievement in General Science. Considering all the handicaps of the film students, a bare equality, or even a slightly unfavorable inequality, would have been compatible with the theory that the films are of positive value. That the X groups should actually make a greater gain than the C groups under the circumstances and conditions described above is, we believe, very strong if not incontrovertible evidence of the value of classroom films of the type here used.

In certain respects the evidence from individual cities is stronger than the evidence from all the cities taken as a group. Let us consider, for example, the data for City A in Table 14. In this city at least three fourths of the C children had intelligence scores above the average of the X students. On Initial Test C2 the C students average more than five points above the X children. This means that at the beginning of the experiment at least 70 per cent of the C students knew more General Science than the average X student knew. In spite of this intellectual and achievement handicap the X group advances twenty points while the C group advances only nineteen points.

In City C the X group is measurably above the C group in intelligence and also in initial achievement in General Science, and the X students gain twenty-one points while the C students advance only sixteen points; but the difference between X and C gains in City C is five times as great as the difference in City A. Inspection of the results for other individual cities is left to the interest of the reader. That the superiority of the X group is both large and consistent will be made clear in Chapter VII where the results

of the Comprehensive and Topical Tests will be compared in considerable detail in the light of all the information available on each group.

Geography. Table 15 is exactly parallel to Table 14 and shows for Geography students what Table 14 shows for General Science students. The data of Table 15 are apparently more favorable to the X classes than are those of Table 14. This is an indication of the superiority of the Geography over the General Science films, which will be discussed in a later chapter.

The evidence of Table 15 is so clear and generally consistent that it may be summarized in a small space. In eight of the twelve cities the X students have an average Initial C2 Test score in Geography lower than that of the C students. At the end of the experiment the X children in eleven out of twelve cities show substantial superiority of gain over the C students. In the twelfth city the difference is negligible. Taking all of the cities together we find that the average intelligence score of the X students is about one tenth of the standard deviation below the average of the C students; that the average Initial C2 Test score of the X group is nearly one tenth of a standard deviation below the Initial C2 Test average of the C group; and that the average score of the X students in Final Test C2 is nearly three tenths of the standard deviation above the C average.

Stated in terms of gains, the X children advance 23 points while the C children advance 19.2 points, a difference of 3.8 points in favor of the film students. This difference is about 18 per cent of the mean gain of the X and C students together, and is about one third of the standard deviation of the scores on Final Test C2 of the X and C students treated as one group.

Table 15. Showing for All X and C Students who Took Initial C2 Tests and Final C2 Tests:

Median chronological ages, intelligence tests means and S.D.'s, differences between X and C intelligence means expressed as fractions of the sigmas of X + C intelligence measures, Initial and Final Geography test medians, median gains of X and C groups, and the difference between the gains of X and C groups.

Geography

Cities	No. of Cases	Median C Ages	Intell. Means	Intell. S.D.'s	Intell. $\frac{M_x - M_c}{S.D._{x+c}}$	Init. C2	Final C2	Gain	X Gains Minus C Gains
A	X 390	11.9	100.85	18.45		37.7	62.0	24.3	
	C 369	11.7	108.40	15.60		36.9	57.7	20.8	
	X + C 759		104.50	17.54	−.43				+3.5
B	X 229	12.4	96.31	16.15		39.8	65.0	25.2	
	C 198	12.7	100.96	18.05		42.8	65.1	22.3	
	X + C 427		98.46	16.49	−.28				+2.9
C	X 279	11.0	11–7	16.24 Mos.		42.7	67.7	25.0	
	C 297	11.2	12–3	15.24 Mos.		43.9	63.1	19.2	
	X + C 576		12–0	15.7 Mos.	−.38				+5.8
D	X 235	11.8	103.38	12.60		35.4	57.6	22.2	
	C 202	11.9	101.38	17.95		36.8	54.4	17.6	
	X + C 437		102.45	15.35	+.13				+4.6
E	X 380	10.2	109.26	12.70		41.6	65.3	23.7	
	C 243	10.2	113.80	10.95		47.4	64.6	17.2	
	X + C 623		110.96	12.27	−.37				+ 6.5
F	X 254	11.3	106.98	15.05		42.7	68.6	25.9	
	C 194	10.8	109.55	15.20		43.2	65.4	22.2	
	X + C 448		108.09	15.17	−.17				+8.7
G	X 237	11.1	111.78	16.10		40.8	60.3	19.5	
	C 238	11.2	111.20	16.40		43.1	62.9	19.8	
	X + C 475		111.48	16.26	+.04				−.3
H	X 83	11.0	104.25	18.40		29.8	57.9	28.1	
	C 111	10.7	108.54	17.25		33.6	51.5	17.9	
	X + C 194		106.69	17.88	−.24				+10.2
I	X 104	10.7	106.04	14.45		34.8	65.8	31.9	
	C 103	11.6	110.58	13.85		41.5	62.2	20.7	
	X + C 207		108.29	14.34	−.32				+10.3
J	X 153	10.9	100.24	16.90		33.8	55.8	22.0	
	C 174	10.6	100.78	17.05		34.6	55.8	21.2	
	X + C 327		100.53	16.98	−.03				−.8
K	X 87	10.8	109.50	20.51		36.9	59.2	22.3	
	C 83	11.3	98.91	15.05		33.0	54.9	21.9	
	X + C 170		104.43	18.66	+.57				+.4
L	X 514	11.4	100.84	18.05		33.3	59.9	26.6	
	C 470	11.9	98.16	17.45		33.9	55.7	21.8	
	X + C 984		98.55	17.91	+.26				+4.8

Medians for all cities	X 2944		38.1	62.7	24.6	
	C 2684	Intell. Average	39.0	59.7	20.7	
	X + C 5628	−.1 sigma				+3.9
Means for all cities	X		38.75	61.7	23.0	
	C		39.61	58.8	19.2	
	X + C		39.17	60.29	21.12	+3.8
Sigmas for all cities	X		10.50	11.6		
	C		10.50	11.1		
	X + C		10.51	11.45		

$\frac{G_x - G_c}{S.D._{x+c}} = \frac{3.8}{11.45} = 33.2\%$ S.D. Scores $\qquad \frac{G_x - G_c}{G_{x+c}} = \frac{3.8}{21.12} = 17.9\%$ Mean Gain

FINAL TEST AVERAGE SCORES OF EXPERIMENTAL AND CONTROL GROUPS

Average scores on C3 Tests. Tables 14 and 15 compared the gains of X and C students as measured by a one-hundred item test given at the beginning of the experiment and repeated at the end. This procedure is designed to take account of initial differences in achievement as well as final differences in achievement.

Table 16 is based on a General Science Test of 92 items and a Geography Test of 113 items which were given only at the end of the experiment. In view of the inferiority of the X classes as compared with C classes with respect to initial achievement in General Science and Geography, as measured by the total Initial Test, the results of which are set forth in Tables 6 and 7, and as measured by Initial Test C2 as set forth in Tables 14 and 15, it seems safe to assume that with respect to the ability measured by Test C3, the X children are at least not superior to the C children. The comparisons of Table 16 are consistently and materially favorable to the film groups. Taking all the cities together, the average score of the X students is about 78 per cent of a standard deviation above the average of the C students in General Science, and about 84 per cent of a standard deviation above in Geography. From these figures it is obvious that the films have made a consistent and large contribution to the X students which the C students did not get.

The validity of this conclusion depends upon whether Tests C3 in General Science and in Geography were fair to the C students. We reproduce these tests in the Appendix so that the reader may judge for himself. Our judgment is that the tests are entirely fair to the C students and we further believe that if Test C3 had been given at the beginning of the experiment the average score of the C students

TABLE 16. SHOWING MEDIAN SCORES OF X AND C GROUPS ON C3 TESTS IN GENERAL SCIENCE AND GEOGRAPHY IN EACH OF THE TWELVE CITIES SEPARATELY AND TOGETHER

The table also shows for all twelve cities treated as one unit, the means and S.D.'s of the scores of X and C groups, separately and together, and the differences between the X and C median scores expressed in terms of the S.D.'s of the test scores from all twelve cities.

	GENERAL SCIENCE				GEOGRAPHY			
Cities	No. of Cases	Medians	$\frac{M_x - M_c}{S.D._{x+c}}$	Rank	No. of Cases	Medians	$\frac{M_x - M_c}{S.D._{x+c}}$	Rank
A	X 135	75.1			391	86.9		
	C 197	63.3	+1.22 S.D.	3	377	68.6	+1.27 S.D.	1
B	X 71	67.5			232	88.1		
	C 80	59.5	+.83 S.D.	8	205	73.9	+.98 S.D.	5
C	X 223	73.5			283	93.3		
	C 255	62.4	+1.15 S.D.	4	298	77.3	+1.11 S.D.	2
D	X 233	65.4			250	78.6		
	C 210	55.96	+.98 S.D.	7	206	66.9	+.81 S.D.	10
E	X 137	66.2			400	88.9		
	C 126	65.0	+.12 S.D.	12	310	76.9	+.83 S.D.	9
F	X 155	73.2			253	92.6		
	C 156	60.1	+1.36 S.D.	2	188	80.1	+.87 S.D.	8
G	X 66	71.7			249	84.7		
	C 66	61.6	+1.04 S.D.	6	237	76.8	+.55 S.D.	12
H	X 38	67.5			86	79.6		
	C 36	52.5	+1.55 S.D.	1	108	64.4	+1.05 S.D.	3
I	X 166	58.9			108	87.96		
	C 82	54.5	+.46 S.D.	10	104	74.7	+.92 S.D.	6
J	X 127	71.1			153	77.1		
	C 131	60.9	+1.06 S.D.	5	175	68.6	+.59 S.D.	11
K	X 27	69.5			83	85.6		
	C 31	62.3	+.74 S.D.	9	83	72.95	+.88 S.D.	7
L	X 40	70.9			523	83.3		
	C 44	66.6	+.45 S.D.	11	464	68.3	+1.04 S.D.	4
Medians for all cities	X 1418	68.74			3011	86.27		
	C 1414	60.54	+.85 S.D.		2755	72.37	+.96 S.D.	
Means for all cities	X 1418	67.81			3011	83.82		
	C 1414	60.25	+.782 S.D.		2755	71.62	+.845 S.D.	
	X + C 2832	64.04			5766	77.99		
Sigmas for all cities	X 1418	10.00			3011	14.00		
	C 1414	7.65			2755	12.00		
	X + C 2832	9.67			5766	14.43		

would have been at least equal to (and probably higher than) the average score of the X students.

These tests would undoubtedly be unfair to the C students if they included questions about which information could not be secured by the C students from sources available to them, and about which the X students had secured no information except from the specific films used in this experiment. That this is not the case is indicated by the substantial average scores which the C students made on these tests as compared with the average scores of the X students. The C students not only made substantial scores on the C3 Tests (Table 16) but they made substantial scores on practically every individual item in the C3 tests, as will shortly appear in Table 18 in this chapter.

Average scores on total Final Test (C2 + C3). Table 17 is parallel to Table 16 and shows comparative median scores of X and C groups in each city, and in all cities together, for the total Final Tests (C2 plus C3) in General Science and in Geography. The indications of this table are parallel to those of Table 16. The reliability of the total Final Test in General Science is $.804 \pm .017$, and of the total Final Test in Geography is $.941 \pm .008$. These total Final Tests (C2 + C3) in General Science and in Geography included approximately two hundred objectively scored questions each (Table 1).

Assuming equality of the average scores on these tests for X and C groups at the beginning (and it would seem more reasonable to assume the superiority of the C groups for the reasons mentioned above) the differences between the X and the C median scores set forth in Table 17 are as significant as the differences between the X and C gains described in Tables 14 and 15.

In General Science the superiority of the X over the C groups is more than one third of the standard deviation of

Table 17. Showing Median Scores of X and C Groups on Total Final Tests (C2 + C3) in General Science and Geography in Each of the Twelve Cities Separately and Together

The Table also shows the means and S.D.'s of the scores of X and C groups, separately and together, for all twelve cities treated as one unit; and the differences between the X and C median scores expressed in terms of the S.D.'s of the test scores of all twelve cities.

	General Science			Geography		
Cities	No. of cases	Medians	$\frac{M_x - M_c}{S.D._{x+c}}$	No.	Medians	$\frac{M_x - M_c}{S.D._{x+c}}$
A	X 126 C 186	133.6 131.7	+.1 S.D.	366 349	148.8 125.97	+.95 S.D.
B	X 63 C 75	124.8 118.9	+.31 S.D.	217 192	152.8 140.0	+.53 S.D.
C	X 219 C 245	141.9 123.0	+1.0 S.D.	272 290	161.1 139.0	+.92 S.D.
D	X 220 C 188	115.8 107.7	+.43 S.D.	230 186	135.3 120.5	+.62 S.D.
E	X 122 C 121	125.0 132.8	−.42 S.D.	376 232	155.1 141.5	+.57 S.D.
F	X 152 C 154	140.0 120.2	+1.05 S.D.	250 197	160.9 144.3	+.69 S.D.
G	X 55 C 61	141.5 116.9	+1.3 S.D.	230 221	144.6 139.2	+.23 S.D
H	X 35 C 31	126.1 122.2	+.21 S.D.	80 101	135.0 116.9	+.76 S.D.
I	X 141 C 78	100.2 97.5	+.14 S.D.	102 103	151.9 134.8	+.71 S.D.
J	X 125 C 129	137.5 125.3	+.65 S.D.	142 172	131.7 124.0	+.32 S.D.
K	X 24 C 26	133.3 130.0	+.18 S.D.	81 83	145.4 128.3	+.71 S.D.
L	X 37 C 43	129.7 120.8	+.47 S.D.	510 445	141.6 123.6	+.75 S.D.
Medians for all cities	X 1319 C 1337	129.32 121.61	+.41 S.D.	2856 2571	148.39 131.19	+.72 S.D.
Means for all cities	X 1319 C 1337 X + C 2656	127.34 120.41 123.85	+.367 S.D.	2856 2571 5427	145.14 130.02 137.98	+.631 S.D.
Sigmas for all cities	X 1319 C 1337 X + C 2656	20.0 17.0 18.87		2856 2571 5427	24.0 21.3 23.98	

the scores of both X and C groups; and in Geography the superiority is more than six tenths of the standard deviation. In some of the cities the superiority of the X over the C group in both Tables 16 and 17 is greater than the standard deviation. In one or two cases the distribution of X scores is entirely above the distribution of C scores. Only in one instance, that of City E, in General Science, is the C group ahead of the X group. This appears to be a genuine superiority of the C students in that city over the X students, and may be considered the exception which proves the validity of the general conclusion that the film students achieve more in a given time than the C students.

Both the X and C students in General Science in City E achieve high average scores, 125 and 132.8, respectively. The case of this city is discussed in detail in Chapters VII, VIII, and IX. Suffice it to say here that the X classes did not have any real chance with a test which was based strictly upon the Study Guides. Reference to Table 14 will show that the average intelligence score of the C students in City E is about one third of the standard deviation above that of the X students. Our purpose in stressing the superiority of the C students in City E in this connection is that it fortifies our judgment as to the fairness of Test C3 and of the total Final Test to the C students. The higher average scores of the C students in City E in Table 17, and the high average score in Table 16 in General Science, show that the materials of the total Final Test can be learned without the aid of the films, and under the exceptional conditions obtaining in City E they *were* learned by the C group more effectively than by the X group. The superiority of the X students in all other cities in Table 17 shows, however, that in general the film students can and do learn more than the C students in spite of the general handicaps described above. Conclusive evidence of the fairness of the C3 Tests

in General Science and in Geography to the C students is presented in Table 18.

TABLE 18. CORRELATIONS BETWEEN X AND C DIFFICULTIES OF INDIVIDUAL QUESTIONS IN THE COMPREHENSIVE TESTS, BASED UPON THE DATA ON INDIVIDUAL ITEMS IN THE TESTS GIVEN IN APPENDIX II AND APPENDIX III

The X difficulty of a question is measured by the proportion of X students that answered it correctly; the C difficulty is measured by the proportion of C students that answered it correctly. In the General Science C2 Tests the X difficulties are based on the responses of 1340 X students, and the C difficulties on the responses of 1346 C students; in the Geography C2 Tests, the difficulties are based on the responses of 2944 X and 2684 C students. The C3 Test-item difficulties are based on all returns from Cities A, B, C, and D.

GENERAL SCIENCE

Test		r_{xc}	M_x	M_c	$S.D._x$	$S.D._c$	Number of Questions
Initial	C2	0.984	41.6	48.6	18.13	21.15	100
Final	C2	0.957	58.3	65.0	19.28	21.39	100
Final	C3	0.816	73.8	66.1	16.83	17.26	92

GEOGRAPHY

Initial	C2	0.985	38.6	39.2	19.3	20.3	100
Final	C2	0.973	60.8	58.5	24.4	24.7	100
Final	C3	0.800	74.7	62.9	15.90	16.38	113

Impartiality of C3 Tests. The correlations of Table 18 show that the C3 Test questions which were hard for the C groups were also hard for the X groups; and questions that were easy for the X were also easy for the C groups. The difference is that, although the C students are superior on some questions, the X groups are superior on a majority of the questions at all levels of difficulty. All the questions in these tests are on points specifically mentioned in the Study Guides, and are points about which the C students learned quite effectively; but the X students, with the aid of the films, learned more effectively about them than the C students. There was not one question in all these

tests which turned out to be relatively hard for C and relatively easy for X groups. The correlations between X and C difficulty ratings of individual questions are expectedly lower for Test C3, but even here they are not lower than 0.80. These correlations indicate that the superiority of the X groups set forth in Tables 14–17 is not due to the presence of a few questions which were very difficult for C and very easy for X students, but rather to the general and consistent superiority of X students at all levels of difficulty. If there had been one or more questions answered correctly by only 10 per cent of C students and by as many as 80 per cent or 90 per cent of X students, it could be inferred that, in spite of our restricting the questions meticulously to items included in the Study Guides, some of them might be unfair to the C students. But there were no such questions.

In the Geography C3 Test, there were only two questions answered correctly by less than 20 per cent of the C students; these two questions were also the hardest for the X students, being the only two answered correctly by less than 35 per cent of the X students, and one of these was answered correctly by less than 20 per cent of the X students. In the General Science C3 Test there were similarly only two questions answered by fewer than 20 per cent of the C students. One of these was the only question answered by fewer than 30 per cent of the X students, and the other was relatively difficult for the X students, being answered correctly by fewer than 60 per cent of them. The second and third hardest questions for the X group were answered by 30 to 39 per cent of the X, and by 40 to 49 per cent of the C students.

In the Geography C3 Test the one question answered by at least 95 per cent of the X students was answered by at least 90 per cent of the C students. Of the twenty ques-

tions answered correctly by 90 per cent or more of the X students, ten were correctly answered by 80 per cent or more of the C students; seventeen by 70 per cent or more; nineteen by 65 per cent or more; and all twenty by 60 per cent or

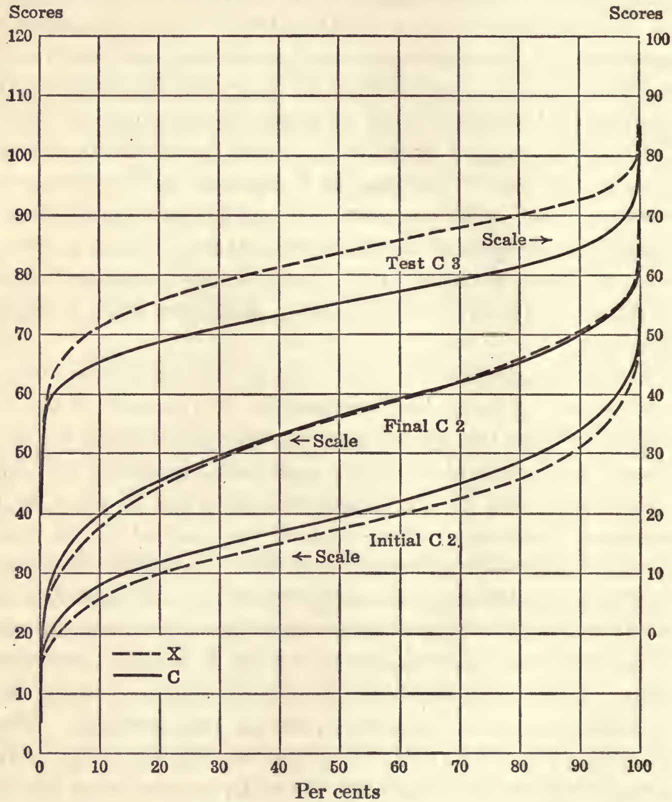

CHART I. PERCENTILE GRAPH SHOWING RELATIONS OF SCORES OF X AND C GENERAL SCIENCE GROUPS ON INITIAL TEST C2, FINAL C2, AND TEST C3 WHICH WAS GIVEN ONLY AT THE END OF THE EXPERIMENT

The curves for Initial and Final Tests C2 are read to the scale at the left, and for Test C3 to the scale at the right. (The C3 curves were drawn to the scale at the right to separate them more distinctly from the Final C2 curves.)

more of the C students. In the General Science C3 Test there were five questions answered correctly by 95 per cent or more of the X students; four of these were answered correctly by 90 per cent or more of the C students, and one by

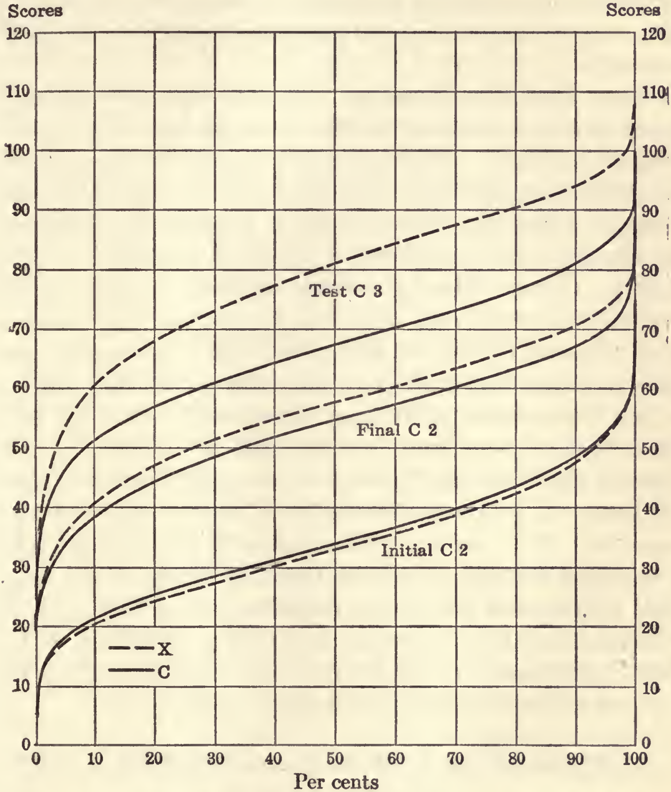

CHART II. PERCENTILE GRAPH SHOWING RELATIONS OF SCORES OF X AND C GEOGRAPHY GROUPS ON INITIAL TEST C2, FINAL C2, AND TEST C3 WHICH WAS GIVEN ONLY AT THE END OF THE EXPERIMENT

at least 60 per cent. Of the eighteen questions answered correctly by at least 90 per cent of the X students, eight were also answered by at least 90 per cent, twelve by at least 80 per cent, and fifteen by at least 70 per cent of the C students. The remaining three were answered by at least 50 per cent, 55 per cent, and 60 per cent, respectively, of the C students.

These facts concerning the very easy and the very hard questions are detailed for the convenience of the non-technical reader. They confirm concretely for the extreme levels of difficulty the generalized indications of the correlations of Table 18. The two lowest correlations, as was to be expected, are those for the C3 Tests, but these are still 0.80 or above. The indications are just what we should expect from a test based strictly on the written Study Guides, and including only items which text writers commonly consider as proper material for written presentation; but emphasizing items which, while usually presented in writing, lend themselves also to direct visual media of instruction. On some of the items, the C students were superior, but on most of them at all levels of difficulty the X students were notably superior. Far from being unfair to the C students, the tests are almost certainly unfair to the X students, in the sense that they do not allow them sufficient leeway at the top to display fully their clearer understanding and grasp of the facts, processes, inter-relations, and implications of the subject matters studied in this experiment.

VARIABILITY OF SCORES IN EXPERIMENTAL AND CONTROL GROUPS

In Tables 14 to 16, inclusive, the reader will have noticed that without exception the standard deviations of the scores of the X group are greater than the corresponding standard deviations of the C scores on the Final Tests; and that in

Tables 14 and 15 the standard deviations of the X and C groups on the Initial Tests are almost exactly equal. The variability of the C scores is greater at the end than at the beginning of the experiment, but the C variabilities do not increase as much as the X variabilities. One possible interpretation is that the films gave special stimulation to the superior children in the X group and offered such wide opportunities for unusual ability to manifest itself in concrete achievement that the bright students in the X group more nearly approximated their real abilities than the bright students in the C classes did. While this suggestion is thoroughly consistent with the known facts of the psychology of learning in bright and dull children, it should be said that we have no specific evidence to support it.

A MINIATURE EXPERIMENT

After presenting the evidence of Tables 14 to 17, inclusive, involving thousands of cases, it may seem anticlimactic to discuss the results from three classes averaging less than thirty students each. Our excuse for including Table 19 in this report is that the situation described is almost a perfect experimental set-up.

The facts regarding this miniature experiment are as follows: one of our X teachers, on being informed of the general ruling that X and C classes should be in separate buildings, requested the privilege of teaching one of her two X classes without the aid of the films, as though it were a C class. As a further check it was decided to install another C class in the same school, taught by a different teacher.

The three classes were perfectly matched as to median intelligence quotient; but the lowest I.Q. in the CX class was 86, and there were eight pupils in the X class with I.Q.'s below 85. The two classes taught by the X teacher

Table 19. Showing Comparative Gains of One X and Two C Geography Classes from One School, the X and One C Class being Taught by the Same Teacher, and the Other C Class by a Second Teacher

Average Scores on Indicated Tests								
Groups	Cases	Intelligence Measures	Initial Total	Initial C2	Final C2	Test C2 Gain	Final C3	Final Total
X	32	108.1	41.6	28.6	58.1	29.5	80.0	134.4
CX	27	109.2	38.6	30.4	52.1	21.7	68.1	121.7
C	27	109.4	34.2	30.3	41.5	11.2	60.0	96.3

Superiority of X Class Expressed in Several Ways

		Initial-Final Tests C2 Gains	Test C3 Scores	Total Final Test (C2+C3) Scores
		$\frac{G_x - G_c}{G_{cx} \text{ or } G_c}$	$\frac{M_x - M_c}{S.D._{x+c}}$	$\frac{M_x - M_c}{S.D._{x+c}}$
Superiority of X Class over	CX Class	37% Gain_{cx}	82% S.D.	53% S.D
	C Class	87% Gain_c	140% S.D.	159% S.D.

were fairly closely matched as to total Initial Test scores, and all three classes were fairly well matched as to average score on Initial Test C2, with a slight disadvantage to the X class of about two points. The teacher of the X class has long been known for her exceptional success in the use of the project method (projects undertaken by the students), particularly in the line of securing and setting up concrete exhibits bearing on her subject, namely, Geography.

The teacher of the straight C class, so far as we could determine the facts, did not use exhibits and projects as extensively as the teacher of the X students.

It should be said that the X teacher proposed this miniature experiment as a means of showing what (if anything) and how much the films could add to the experience of Geography classes which enjoyed work with concrete materials and exhibits on a scale as extensive as was customary

in her classes. She has long been an ardent believer in the values of good classroom films, but as a matter of scientific interest wished to learn whether such films would add as much to the experience of "project-method-classes" as to that of classes doing little or no project work.

At the end of the experiment this teacher gave it as her opinion that her C class would show up as well on the Final Tests as her X class. This opinion was based on the fact that there were eight pupils in the X class with I.Q.'s below the lowest I.Q. in the CX class, and on the observation that the C students in her charge had voluntarily prepared more exhibits, had collected more illustrative materials, and had carried out more projects than the X class in her charge, and in general had shown greater zeal. The zeal of the C class was no doubt enhanced by the feeling of friendly rivalry which developed, and by the determination of the C students to overcome the advantage which they supposed the films gave to the X students.

Table 19 completes the account of this miniature experiment. The X class is as far above the C class that was taught by that X teacher as the latter is above a straight C class taught by a teacher who had no access to the films. The superiority of the CX class over the C class is probably due largely to the extensive use of collections, exhibits and projects in the CX class; but it is not improbable that its superiority is at least partially due to the fact that its teacher was using the films during the class period immediately preceding. However that may be, the superiority of the X class over the CX class is both large and, almost beyond question, due entirely to the use of the films in the X class. The X and CX classes, so far as we can tell, were equal in all significant respects, even to having the same teacher, the only difference being that the X class had the films and the CX class did not have them.

Using the standard deviations of Tables 14 to 17, inclusive, we find that the gain of the X class is 68 per cent of the standard deviation greater than that of the CX class, and 160 per cent of the standard deviation greater than that of the C class. Put in another way, we find that the difference between the X and CX gains is equal to 37 per cent of the average CX gain, and to 87 per cent of the average C gain. In terms of Test C3 the X class secured an average score 82 per cent of the standard deviation above that of the CX class and 140 per cent of the standard deviation above that of the C class. In terms of the total Final Test, the X class secured an average score 53 per cent of the standard deviation above that of the CX class, and 159 per cent of the standard deviation above the average of the C class. The significance of such large differences is patent.

GAINS ANALYZED BY SEX AND SCHOOL GRADE

Table 20 shows the gains of X and C students according to sex and to grade placement. No attempt will be made to discuss this table in detail. There are no consistent sex differences except perhaps in General Science, where the boys seem to gain slightly more than the girls.

If we may discount the Fourth Grade Geography difference between X and C gains, it appears that there is a slight positive correlation between superiority of X gains over C gains and grade placement. This appears in the last column of Table 20.

In Seventh Grade General Science the X group gains one point less than the C group; in the Eighth Grade the X students gain two points more, and in the Ninth Grade six points more than the C groups. In Geography the Fourth Grade shows a seven-point advantage to the X group, the Fifth Grade a two-point advantage, and the Sixth Grade a five-point superiority of gain of X over C students.

TABLE 20. SHOWING RELATIVE GAINS OF BOYS AND OF GIRLS IN EACH GRADE, AND RELATIVE GAINS OF ALL STUDENTS IN EACH GRADE, THE GAINS BEING SHOWN SEPARATELY FOR X AND C GROUPS

GENERAL SCIENCE

Grade	Boys				Girls				Boys and Girls				
	No. of Cases	Md. Init.	Md. Fin.	Gain	No. of Cases	Md. Init.	Md. Fin.	Gain	No. of Cases	Md. Init.	Md. Fin.	Gain	Gains in Score Points
7th	X 294	39.5	58.1	18.6	237	36.0	48.4	12.4	531	38.0	54.1	16.1	−1
	C 255	44.3	62.3	18.0	170	40.3	53.2	12.9	425	42.4	59.5	17.1	
8th	X 239	48.2	68.0	19.8	346	43.1	62.0	18.9	585	44.6	64.4	19.8	+2
	C 367	47.4	65.0	17.6	352	42.9	59.7	16.8	709	45.0	62.7	17.7	
9th	X 123	49.9	68.6	18.7	101	45.6	65.1	19.5	224	47.5	67.0	19.5	+6
	C 95	52.0	65.8	13.8	138	45.0	57.2	12.2	233	47.7	61.0	13.3	

GEOGRAPHY

Grade	Boys				Girls				Boys and Girls				
	No. of Cases	Md. Init.	Md. Fin.	Gain	No. of Cases	Md. Init.	Md. Fin.	Gain	No. of Cases	Md. Init.	Md. Fin.	Gain	Gains in Score Points
4th	X 98	39.7	64.0	24.3	94	33.9	60.0	26.1	192	36.8	61.9	25.1	+7
	C 81	47.9	64.9	17.0	86	42.8	62.3	19.5	167	45.5	63.8	18.3	
5th	X 649	39.1	63.9	24.8	709	34.4	57.4	23.0	1368	36.4	60.3	23.9	+2
	C 553	39.2	60.2	21.0	586	34.4	54.6	20.2	1139	36.6	57.7	21.1	
6th	X 669	42.8	67.5	24.7	665	37.5	62.6	25.1	1334	39.9	65.0	25.1	+5
	C 653	43.6	63.6	20.0	725	37.8	57.9	20.1	1378	40.2	60.7	20.5	

Tables 21 and 22 are appended to this chapter for the sake of later investigators who may wish to analyze more thoroughly than we have been able to analyze, the relations of X and C gains to sex and to grade placement of students. The situation in City I, in Table 22, is one which merits particular attention. Reference to Table 15 will show that in spite of the disparity of grade placement of X and C students, the X group made a gain ten points larger than that of the C students.

TABLE 21. SHOWING NUMBER OF BOYS AND GIRLS TAKING INITIAL AND FINAL TESTS C2 IN EACH GRADE FOR EACH CITY

GENERAL SCIENCE

Cities		Seventh Grade			Eighth Grade			Ninth Grade		
		Boys	Girls	Total	Boys	Girls	Total	Boys	Girls	Total
A	X				29	115	144			
	C				96	111	207			
B	X				41	30	71			
	C				40	39	79			
C	X				108	127	235			
	C				118	124	242			
D	X	111	101	212						
	C	90	79	169						
E	X	60	64	124						
	C	81	44	125						
F	X							70	87	157
	C							63	94	157
G	X							36		36
	C							15	35	50
H	X	35		35						
	C	31		31						
I	X	50	40	90		44	44			
	C	14	17	31	23	24	47			
J	X	38	32	70	32	23	55			
	C	39	30	69	35	33	68			
K	X							17	14	31
	C							17	9	26
L	X				29	7	36			
	C				41	4	45			
Total	X	294	237	531	239	346	585	123	101	224
	C	255	170	425	353	352	709	95	138	233

TABLE 22. SHOWING NUMBER OF BOYS AND GIRLS TAKING INITIAL AND FINAL TESTS C2 IN EACH GRADE FOR EACH CITY

GEOGRAPHY

Cities		Fourth Grade			Fifth Grade			Sixth Grade		
		Boys	Girls	Total	Boys	Girls	Total	Boys	Girls	Total
A	X				72	81	153	114	123	237
	C				75	84	159	95	115	210
B	X							118	111	229
	C							96	102	198
C	X				53	71	124	80	75	155
	C				66	59	125	79	93	172
D	X							120	115	235
	C							104	98	202
E	X	87	80	167	81	82	163			
	C	81	86	167	33	43	76			
F	X				59	59	118	71	65	136
	C				65	59	124	29	41	70
G	X				96	113	209	12	16	28
	C				49	49	98	73	67	140
H	X				24	31	55	13	14	27
	C				37	48	85	14	12	26
I	X	11	14	25	19	23	42	23	14	37
	C							50	53	103
J	X				74	79	153			
	C				97	77	174			
K	X				35	42	87			
	C				32	53	85			
L	X				136	128	264	118	132	250
	C				99	114	213	113	144	257
Total	X	98	94	192	649	709	1368	669	665	1334
	C	81	86	167	553	586	1139	653	725	1378

PROBABLE ERRORS OF DIFFERENCE BETWEEN X AND C GROUPS

In this report an effort has been made to present the findings in a manner that is simple and understandable to non-technical readers, without at the same time slighting any of the fundamental criteria of scientific investigation or withholding significant data which might be of use to technically trained scientists in evaluating the data or in checking up on our interpretations. At the end of Chapter II we presented such data as we had on the reliability and validity of the Comprehensive Tests. The present chapter is primarily concerned with differences and gains, and while we believe that the differences and gains are so large and so consistently in favor of the film classes that the common sense layman's view is adequate to establish the conclusions set forth, nevertheless many readers, we believe, will desire to see some exact indication of the statistical reliability of the differences from which these conclusions have been drawn. We therefore present without comment Table 23, showing such data as we have been able to secure on the probable errors of the differences in the average scores and gains of X and C groups as set forth in Tables 14 and 15, above.

The non-technical reader may pass over this table with scant attention and little loss to the main argument of the report if he will only keep in mind that the differences in favor of the X groups are statistically reliable to an entirely satisfactory degree. In General Science the superiority of gain of 1340 X students over the 1346 C students is more than four times as great as the probable error of the difference between their average gains. In Geography, the 2944 X students have an excess over the gain of the 2684 C students which is more than thirteen times as great as the probable error of the difference in their gains. If we consider

TABLE 23. SHOWING RATIOS OF DIFFERENCES TO PROBABLE ERRORS OF THE DIFFERENCES BETWEEN THE INITIAL AND FINAL AVERAGE SCORES AND BETWEEN THE AVERAGE GAINS OF X AND C GROUPS SET FORTH IN TABLES 14 AND 15

These figures are based on all returns from all twelve cities — 1340 X students and 1346 C students in General Science, and 2944 X and 2684 C students in Geography. In the last column at the right the factor of correlation between initial and final scores has been partially accounted for, the coefficient used being the correlation between initial and final means of the twelve cities. In cases where the difference is more than fifty times its P.E., however, an assumed *r* of 0.60 was used. The factor of reliability of the tests was not accounted for in calculating these probable errors.

GENERAL SCIENCE

	Group	Mean	*r* (Means)	Difference ÷ P.E. difference	Difference ÷ P.E. difference (*r*)
Initial Scores	(X + C)	44.42			
Final Scores	(X + C)	60.39	0.600	77.75	121.77
Initial Scores	X	43.32			
Final Scores	X	60.18	0.795	56.71	120.43
Initial Scores	C	45.52			
Final Scores	C	60.59	0.875	53.42	145.90
Initial Scores	X	43.32			
Initial Scores	C	45.52		8.37	
Final Scores	X	60.18			
Final Scores	C	60.59		1.30	
Gains (score points)	X	16.86			
Gains (score points)	C	15.07		4.37	10.27

GEOGRAPHY

	Group	Mean	*r* (Means)	Difference ÷ P.E. difference	Difference ÷ P.E. difference (*r*)
Initial Scores	(X + C)	39.17			
Final Scores	(X + C)	60.29	0.50	1446.60	1973.80
Initial Scores	X	38.75			
Final Scores	X	61.70	0.73	117.99	192.37
Initial Scores	C	39.61			
Final Scores	C	58.80	0.92	96.87	154.01
Initial Scores	X	38.75			
Initial Scores	C	39.61		4.55	
Final Scores	X	61.70			
Final Scores	C	58.80		14.21	
Gains (score points)	X	22.95			
Gains (score points)	C	19.19		13.54	21.80

the factor of correlation between initial and final scores, the differences in gains in favor of the X groups in General Science and Geography are, roughly, seven and twenty-one times as great as the probable errors of the differences, respectively.

SUMMARY

1. At the beginning of the experiment the X group in General Science was inferior to the C group both in intelligence and in General Science achievement to the extent of about 20 per cent of the standard deviation of the intelligence and the achievement test scores, respectively. At the end of the experiment the X group had gained 1.76 score points more on Test C2 than the pupils of the C group. This difference in favor of the X group is 14.5 per cent of the standard deviation of the scores of both X and C groups; and is 11 per cent of the average gain of both groups. (Table 14.)
2. At the beginning of the experiment the X group in Geography was inferior to the C group in both intelligence and achievement in Geography to the extent of about 10 per cent of the standard deviation of the scores on intelligence and Geography achievement tests respectively. At the end of the experiment the X group had gained 3.8 score points more on Test C2 than the pupils of the C group. This difference in favor of the X group is 33.2 per cent of the standard deviation of the scores of both X and C groups and is 17.9 per cent of the average gain of both groups. (Table 15.)
3. In General Science the X group gained more on Test C2 than did the C group in eight of the twelve cities. (Table 14.)

4. In Geography the X group gained more on Test C2 than did the C group in eleven of the twelve cities. (Table 15.)
5. In Test C3 given only at the end of the experiment, the average score of the X group in General Science was superior to that of the C group by 78.2 per cent of the standard deviation and by 11.8 per cent of the mean of all X and C scores. (Table 16.)
6. In Geography, the Test C3 average score of the X group was superior to that of the C group by 84.5 per cent of the standard deviation, and 15.6 per cent of the mean of all X and C scores. (Table 16.)
7. In both General Science and Geography, as measured by the C3 Tests the X group in each of the twelve cities excelled the C group. (Table 16.)
8. In a minor experiment one Geography teacher taught both an X and a C class, carefully matched as to intelligence. The X class excelled the C class in gain (Test C2) by 68 per cent of the standard deviation of all X and C scores in all cities. (Table 19.)
9. The probable errors of the differences in favor of the X groups are satisfactorily small in all cases; all such differences are four or more times as great as their probable errors.

CHAPTER V

THE TOPICAL TESTS

Purpose of the Topical Tests — Description — Questions of Topical Tests — Method of scoring the Tests — Sampling of papers to be scored — Reliability of samplings used — Reliability of Topical Tests — Total number of Topical Tests scored — Summary.

It was decided at the outset to compare the X and C groups by means of two independent series of tests. This procedure has two purposes. The first purpose was to secure a broader and more reliable measure than could be obtained from one set of tests alone. If two independently organized sets of tests give the same results, they strongly confirm each other. The second general purpose was to measure somewhat different forms of achievement in the two series of tests.

Accordingly, the first set of tests, which we have called the Comprehensive Tests, were prepared, scored, and tabulated under the direction of one of the authors in New York; while the second set of tests, called the Topical Tests, were prepared, scored, and tabulated under the direction of the other author in Chicago. There was, of course, constant and intimate collaboration between the two directors of the study throughout its planning and execution, but it was found convenient to institute this division of labor. It was not until the results of the two series of tests had been tabulated that they were compared. How closely their results agree will be brought out in Chapter VII.

The first set of tests has already been described. It consists of so-called objective tests, that is, of an extensive series of items organized according to the plan of true-false and multiple-choice tests. These tests measure judgment and reasoning to some extent, as well as specific items of information, and have the advantage that they can be scored

objectively by means of a scoring key. Furthermore, they could be given both at the beginning and at the end of the experiment. By this means the standing of the X and of the C groups could be measured at the outset, and their comparative progress during the period of instruction could also be measured.

Purpose of the Topical Tests. The second series of tests, called the Topical Tests, was organized with two purposes particularly in mind. The first purpose was to measure the attainment of the pupils upon each topic individually. Accordingly, the tests were organized by topics and administered to the pupils soon after the completion of the instruction upon each topic. The original plan was to give the tests the day after the instruction on each topic was completed. For administrative reasons this plan was altered and the tests on two topics were given at the completion of the second topic of each consecutive pair of topics.

The second purpose of the Topical Tests was to measure a somewhat different type of attainment than was measured by the Comprehensive, or objective tests. By giving the pupils somewhat greater freedom in organizing their answers and by requiring to some extent answers expressed in other than verbal terms, it was thought that these tests might measure the distinctive outcomes of instruction with the aid of the films to a somewhat greater extent than would tests of the objective type.

Description of Topical Tests. In form the Topical Tests were mostly of the essay type. That is, the pupil was required to answer a question by a sentence or a series of sentences rather than by supplying a single word or by designating which of two or more answers was correct. For example, in the topic entitled "New England Fisheries" the pupils were given the question, "Tell what a cod fisherman does from the start to the finish of a fishing trip to the Grand Banks." Another question on this topic was, "Explain why the Grand Banks

are a good place for cod fishing." An effort was made to frame these questions so as to elicit from the pupils specific and definite statements. In many instances the questions were subdivided so as to guide the pupils in framing their answers. An example of such a question is the following, taken from the topic entitled "From Iron Ore to Pig Iron." "Describe the smelting of iron ore, telling: (*a*) The materials that are put into the furnace. (*b*) How the furnace is heated. (*c*) How the iron is separated from other substances." In order to be sure that the questions could be answered specifically, those formulating the questions worked out the detailed points which they expected the pupils to cover in their answers.

Some of the questions required an answer in other than verbal terms. One type required the drawing of a map. For example, in the topic entitled "New England Fisheries" the following question was included: "Sketch quickly a rough map of the New England coast from Massachusetts to Maine. Show the location of Boston and of Gloucester. Draw and name Newfoundland and the Grand Banks." Another type of question required the pupils to draw a diagram. For example, in the topic entitled "Compressed Air" the following question was used: "Draw a diagram of a hand tire pump showing the valves. Explain how the pump works, telling what happens on the down stroke and on the up stroke."

In order to furnish the pupils a rough guide as to the length of answer which was expected of them, the questions were printed upon blanks, and the amount of space provided for the answer to each question was carefully planned.

The physical make-up of the test blanks may be illustrated by the test upon "Atmospheric Pressure." This test consists of four pages printed upon a folder. These questions were spaced on this folder in accordance with the length of the answer that was expected.

ATMOSPHERIC PRESSURE

Name........................School........................
City..........................Class............Group......

1. With the aid of a diagram explain just how you would make a mercury barometer.
2. Draw a diagram of a lift pump and explain its action.
3. Describe and explain the effect of high altitudes on:
   (1) a mercury barometer
   (2) an aneroid barometer
   (3) breathing
   (4) boiling eggs
   (5) lifting power of a balloon
4. Explain why the sides of an air-tight box made of thin paper are not crushed by the air pressure of 15 pounds to the square inch.
5. What must be done before a hollow body will be crushed by the pressure of the outside air?
6. Describe the action of a vacuum cleaner and explain why the dirt is drawn in.
7. Draw a diagram of a siphon and explain how it works.
8. Explain the chief cause of winds, and tell how this accounts for the land and sea breezes along the shore of a body of water.
9. How may one use a barometer to determine the weight of that part of the sea of air which is directly above a given area?

The entire list of the questions on all twenty of the tests is reproduced in the Appendix. A more complete idea of the character of the tests may be gathered from reading these questions in detail.

In general, the questions are based upon the subject matter of the pupils' guides. Scrupulous care was exercised to include only questions upon topics which appeared in these guides. The purpose of this procedure, of course, was to make sure that the pupils of the C group as well as those of the X group had an opportunity to acquire the information which was called for in the questions. This was an essential feature of the experimental procedure. We cannot, of

course, be sure that the teachers of the C classes emphasized all the points which appeared in the guide, but we took every precaution which it was possible to take to restrict our questions to facts and ideas specifically indicated in the guides.

The questions of the Topical Tests generally fall into two classes. One class of questions may be called "descriptive" and the other "explanatory." In the descriptive questions the pupils were asked to reproduce by words or by diagrams the appearance of something which they had seen. In the explanatory questions they were asked to tell why certain actions or events occurred as they did.

The justification for the use of the descriptive questions is obvious. The purpose of the motion picture films, as of visual education in general, is to give the pupils a concrete notion of the appearance of objects and events in the physical world. It may be assumed, if the objects are properly selected, that this experience is a valuable one for the pupil, and that it constitutes an important part of the foundation of his thinking and action. It is, therefore, appropriate to attempt to measure the accuracy and vividness of these concrete impressions on the part of the X and C groups. The distinctly descriptive questions may be said to constitute a partial measure of the direct contribution of the motion picture.

Questions of the explanatory type were introduced for several reasons. In the first place it is obvious that a complete unit of instruction must include not only concrete experience, but reflection and thought about this experience for the purpose of getting explanations and making generalizations. In conformity with this principle, the teachers' and pupils' guides contained many items which called for discussion and explanation. We may assume that the class time in both groups was occupied in part in discussing these

topics. It is, therefore, proper that questions should be framed upon them.

In the analysis of the results of the tests we shall inquire whether the motion picture film is to have its chief value in enabling the pupils to acquire more definite and clear-cut concrete notions or whether it appears to have equal value in enabling or stimulating the pupils to arrive at explanations of their experiences. In this relation, we must not forget that continued interest in a topic on the part of the children implies at least a willingness on their part to think about that topic in one way or another, and therefore the interest of children may be considered as direct evidence of the thought-evoking powers of the films.

Method of scoring Topical Tests. Since the Topical Tests could not be scored by means of an objective scoring key, it was necessary to choose persons to do the scoring who had qualifications for the task, and to watch the scoring procedure carefully.

The Topical Tests were scored by four persons, two for the Geography and two for the General Science tests. The two persons who scored the tests in Geography had been elementary school teachers. Both had had graduate training in education and successful experience in educational research. The two persons who scored the papers in General Science had been teachers of science in the high school and had also had graduate training in education. All the scorers were selected because of their aptitude for this type of work.

The entire scoring of the Topical Tests was supervised in detail by one of the writers. The general procedure which was followed almost without exception was to go over with the scorers in detail the standards for scoring which were to be followed on each individual item of the test. Before any scoring was done the meaning of the questions was discussed and the types of answers which should be credited were listed. The next step was to do the preliminary scoring on

a number of papers. The list of acceptable answers was then reviewed by the supervisor and the scorers together in order to make final decisions as to what answers should be credited and what credit should be given to each. The scorers then proceeded to score the entire set of papers.

The general method of scoring was to give credit for specific points. It was felt quite emphatically by all the scorers that to score by points gave much more reliable results than would have been yielded by scoring on general impression.

The number of points which could be credited on each question varied according to the character and scope of the questions. In general the points which were to be credited were formulated so as to be as specific as possible. These points could not be determined in advance. The procedure was to read a considerable number of papers and make a list of the points included in the answers which were considered to be legitimate responses. After this list had been made out the papers were scored by using it for reference. If new points appeared in the answers which seemed to merit being credited, they were added to the list.

In deciding which points to credit, a liberal attitude was taken toward the pupils' answers. It was recognized that pupils do not usually read the questions very carefully and that they therefore frequently include in their answers items which are not specifically called for in the questions. If, however, the answers were closely related to the questions, the points were given credit. In most cases each point was given the same weight as every other, but in a few cases in which some points were obviously of much greater importance than others, they were given double weight.

The total number of points which were credited to a given question and the total possible score on a question were indeterminate. They differed on different questions and accordingly the average score on the different questions varied considerably. No attempt was made to make the questions

equal in scope, and this variation was the natural consequence.

As an illustration of the points which were used in scoring the questions, the points which were given credit in Item 4 of the test on the topic, "Bituminous Coal" may be given. The question is, "Tell what the chief dangers in coal mining are, and what things are done to avoid them." On the first part of the question, credit was given for the mention of the following points:

blasting; fires; floods from underground streams; gas or poisonous air; choke damp; fire damp, etc.; caving in of rooms; explosions; bad air, that is, impure air or not enough air; being trapped or having the passageways blocked.

The points which were credited in answer to the second half of the questions are as follows:

testing for gas or bad air; constant inspection and the use of guards; the use of safety lamps; use of pumps for the water; blowing in pure air; supporting the roofs by the use of timbers or by leaving some coal; safety education; the use of signs of caution; sprinkling to lay the coal dust; using the canary bird test; and preventing fires by prohibiting smoking or the use of open lights.

In the scoring procedure, the papers from the X and C groups were mixed together and the scorers did not know in any individual case whether the paper was from one group or the other. This procedure rendered impossible any partiality in scoring.

Sampling of papers to be scored. It is obvious, on a moment's reflection, that it was not practicable to score all the papers. If all the pupils had been present at all tests there would have been approximately 35,680 papers in General Science and 72,190 papers in Geography. Since there were seven to ten questions on each test, the grading of questions on a total sampling basis would obviously be impossible within the time limits at our disposal.

Under the circumstances various methods of sampling

were considered. One method which might be followed would be to select all the papers on a given test from a given city and to select papers from another city on another test. This method, however, would make it impossible to compare the various cities on a given test and would make it impossible to compare the achievement of the pupils on the various topics because of the variations between the cities. It was finally decided to adopt the more elaborate, but much more satisfactory, method of selecting a certain percentage of pupils from each class. This method gave a representation from each city and each class in every test.

A rough calculation indicated that at least ten per cent of the papers might be graded. This would probably not be sufficient to yield uniform samples if the papers were selected at random. The selection was found to be sufficiently representative, however, when the technique of matching on the basis of tested intelligence was used.

The operation of the matching technique is illustrated by Table 24 which shows the essential facts concerning the basis on which the papers to be graded were selected.

The first principle which was applied was that the pupils who were chosen to represent the achievement of the group on the various topics should have approximately the same average ability. In accordance with this principle the average intelligence test score of the successive samples was made as nearly equal to the average of the whole group as possible. The mean I. Q.'s of the students whose papers were selected on each topic appear in the last line of Table 24. This procedure insures that the average intelligence test score of the X and C groups whose papers on a particular topic are scored, shall have the same relation as the average intelligence scores of the entire X and C groups from which the samplings are taken.

The second general principle is that as wide a distribution of pupils as possible should be secured on the tests taken

as a whole. This principle was applied by taking the pupils in turns. Thus practically all pupils were represented in one test or another.

Reliability of samplings used. On the first six topics ten per cent of the papers were selected in the manner which has been described. It was found possible to select and grade twenty per cent of the papers on the last four topics. This gave an opportunity to check up on the reliability of the average scores based on the ten per cent sampling. This was done by tabulating the distribution of scores and calculating the means, standard deviations, the differences between the means, and the probable errors of the differences in the case of four of the Geography topics and four of the General Science topics. The results of the tabulations are given in Tables 25 and 26 on one topic in Geography and one topic in General Science.

In Geography (Table 25) the average difference between the two ten per cent samplings in the case of the X group is .74, and the probable error of the difference is .39, which is more than half the difference. The difference between the means in the case of the C group is only .07 with a probable error of .36. In General Science (Table 26) the differences are $.15 \pm .76$ and $.63 \pm .67$ for the X and C groups, respectively. The differences are insignificant when compared with their probable errors. The differences are in no case larger than 10.9 per cent of the S.D. of the least variable of the two samplings.

A summary comparison between the two ten per cent samplings on all eight topics in which the twenty per cent samplings were made is shown in Table 27. The differences between the two samplings with their probable errors are shown in the column headed $M_a - M_b$. It is apparent that the differences are relatively small, since in only one case is a difference twice the probable error, and in no case larger

TABLE 24. SPECIMEN TABLE SHOWING HOW SELECTION OF PAPERS WAS MADE FOR SCORING THE TOPICAL TESTS *

School.... City.... A Grade.... H–5–1 Group.... Experimental

Pupil's Name	Age	I.Q.	Topic Number									
			1	2	3	4	5	6	7	8	9	10
1......	10–6	115			X							
2......	10–11	106						X				
3......	10–9	102			X							
4......	11–1	116									X	
5......	10–1	108								X		
6......	11–5	83				X						
7......	11–2	112							X			
8......	9–9	131				X						
9......	10–4	118									X	
10......	10–4	100									X	
11......	11–1	119				X						
12......	10–9	114								X		
13......	10–11	109						X				
14......	10–8	115										X
15......	9–11	120				X						
16......	10–11	118									X	
17......	10–3	113								X		
18......	11–1	114									X	
19......	11–6	114										X
20......	10–11	96								X		
21......	10–7	109										X
22......	10–10	112							X			

* The X marks indicate the pupils whose papers were chosen to be scored in the several topics.

TABLE 24 (*continued*)

School.... City.... A Grade.... H–5–1 Group.... Experimental

Pupil's Name	Age	I.Q.	Topic Number									
			1	2	3	4	5	6	7	8	9	10
23......	11–5	111							X			
24......	10–7	110										X
25......	12–5	109					X					
26......	11–0	105							X			
27......	10–7	126						X				
28......	10–7	125							X			
29......	10–5	111					X					
30......	11–9	98						X				
31......	10–11	108	X									
32......	10–6	110	X									
33......	10–8	113	X									
34......	11–3	122	X									
35......	9–7	121		X								
36......	10–7	114		X								
37......	10–5	122			X							
38......	11–6	114			X							
39......	11–6	91		X								
40......	11–1	134								X		
41......	10–7	145					X					
42......	11–0	118										X
43......	12–1	88					X					
44......	11–1	127		X								
45......	10–3	126						X				
Mean I.Q.		113.2	113.3	113.3	113.3	113.3	113.0	113.0	113.0	113.0	113.2	113.2

TABLE 25. COMPARISON OF THE DISTRIBUTION OF SCORES ON TWO TEN PER CENT SAMPLINGS, TO TEST THE RELIABILITY OF THE MEAN SCORES ON THE TEN PER CENT SAMPLING

Topic: Cotton Growing, Geography.

Score	X Group			C Group		
	Ten per cent Selection A	Ten per cent Selection B	Total	Ten per cent Selection A	Ten per cent Selection B	Total
44.5–47.5		1	1			
41.5–44.5	2		2		1	1
38.5–41.5	2	2	4	1		1
35.5–38.5	5	4	9	1	2	3
32.5–35.5	15	6	21	3	4	7
29.5–32.5	24	21	45	5	9	14
26.5–29.5	30	30	60	17	15	32
23.5–26.5	46	49	95	17	25	42
20.5–23.5	49	48	97	44	40	84
17.5–20.5	50	51	101	61	55	116
14.5–17.5	30	47	77	59	58	117
11.5–14.5	26	30	56	37	48	85
8.5–11.5	12	10	22	26	31	57
5.5– 8.5	9	6	15	18	15	33
2.5– 5.5	2	3	5	5	7	12
0– 2.5	1		1	1	1	2
Total	303	308	611	295	311	606
Mean	21.89±.29	21.15±.26	21.52±.19	17.61±.25	17.68±.26	17.64±.18
S.D.	7.44	6.81	7.14	6.36	6.75	
	$M_a - M_b = .74 \pm .39$			$M_a - M_b = -.07 \pm .36$		

than 21.9 per cent of the S.D. of the least variable of the two distributions of scores.

Another method of studying the reliability of the ten per cent sampling is to compare the difference between the mean scores of the X and C groups based on the two ten per cent

TABLE 26. COMPARISON OF THE DISTRIBUTION OF SCORES ON TWO TEN PER CENT SAMPLINGS, TO TEST THE RELIABILITY OF THE MEAN SCORES ON THE TEN PER CENT SAMPLING

Topic: Limestone and Marble, General Science.

Score	X Group			C Group		
	Ten per cent Selection A	Ten per cent Selection B	Total	Ten per cent Selection C	Ten per cent Selection D	Total
47.5–50.5	1		1			
44.5–47.5	2	1	3			
41.5–44.5				1	2	3
38.5–41.5	3	3	6			
35.5–38.5	2	4	6		1	1
32.5–35.5	2	6	8	5	5	10
29.5–32.5	12	6	18	3	7	10
26.5–29.5	11	12	23	8	9	17
23.5–26.5	10	11	21	10	13	23
20.5–23.5	12	11	23	24	20	44
17.5–20.5	16	21	37	20	17	37
14.5–17.5	17	14	31	23	12	35
11.5–14.5	22	15	37	22	17	39
8.5–11.5	15	21	36	13	17	30
5.5–8.5	12	9	21	8	17	25
2.5–5.5	6	7	13	9	11	20
0–2.5		1	1	7	1	8
Total	143	142	285	153	149	302
Mean	19.00±.54	18.85±.53	18.93±.38	16.80±.44	17.43±.50	17.11±.33
S. D.	9.57	9.42	9.48	8.13	8.97	8.55

$M_a - M_b = .15 \pm .76$ $\qquad$ $M_a - M_b = -.63 \pm .67$

samplings. This is done in Table 27*a*. In the first column of figures are shown, for each topic, the difference between the means of the X and C groups on one ten per cent sampling together with the probable errors of the means. In the next column the same difference is shown for the second ten

TABLE 27. SUMMARY COMPARISON OF THE MEAN SCORES OF TWO TEN PER CENT SAMPLINGS ON THE TOPICAL TESTS FOR EIGHT TOPICS, TO SHOW THE RELIABILITY OF THE TEN PER CENT SAMPLING

Topic		N		M_a	M_b	$M_a - M_b$	$S.D._a$	$S.D._b$	$S.D._a - S.D._b$
		a	b						
Cotton	X	303	308	21.89±.29	21.15±.26	.74±.39	7.44±.20	6.81±.19	.63±.28
	C	295	311	17.61±.25	17.68±.26	−.07±.36	6.36±.18	6.75±.18	−.39±.25
Irrigation	X	302	324	11.88±.20	12.03±.21	−.15±.29	5.07±.14	5.52±.15	−.45±.21
	C	301	326	10.29±.19	10.00±.18	.29±.26	4.89±.13	4.80±.13	.09±.18
Bituminous Coal	X	313	302	18.73±.30	18.20±.29	.53±.42	7.92±.21	7.44±.20	.48±.29
	C	299	301	15.67±.27	15.62±.26	.05±.37	6.93±.19	6.75±.19	.18±.27
Iron Ore to Pig Iron	X	291	284	20.40±.34	20.50±.32	−.10±.47	8.70±.24	8.07±.23	.63±.33
	C	295	288	16.57±.37	17.16±.34	−.59±.50	9.33±.26	8.64±.24	.69±.35
Limestone and Marble	X	143	142	19.00±.54	18.85±.53	.15±.76	9.57±.38	9.42±.38	.15±.54
	C	153	149	16.80±.44	17.43±.50	−.63±.67	8.13±.31	8.97±.35	−.84±.47
Sand and Clay	X	143	137	24.35±.54	23.77±.56	.58±.78	9.66±.39	9.72±.40	−.06±.56
	C	141	159	15.85±.50	15.51±.42	.34±.65	8.82±.35	7.86±.30	.96±.46
Reforestation	X	117	125	21.87±.38	21.38±.37	.49±.53	6.06±.27	6.21±.27	−.15±.38
	C	134	136	20.50±.42	20.74±.43	−.24±.60	.23±.30	7.35±.30	−.12±.42
Planting and Care of Trees	X	130	124	22.88±.38	21.88±.41	1.00±.56	6.36±.27	6.69±.29	−.33±.40
	C	144	126	21.79±.42	20.21±.43	1.58±.60	7.47±.30	7.23±.31	.24±.43

per cent sampling. In the last column the differences are shown for the entire twenty per cent sampling. The differences between the X and C groups on the different samplings do not vary significantly from each other.

It is clear, then, that the mean scores which are derived from a sampling of ten per cent of the papers when the sampling is selected in the manner described, are not significantly different from the mean scores on another ten per cent sampling. We may, therefore, conclude that the ten per cent sampling gives a fair representation of the papers as a whole.

Reliability of Topical Tests. An estimate of the reliability of the Topical Tests was arrived at by the split-test method. The test on a single topic was divided into two

TABLE 27a. COMPARISON OF THE DIFFERENCES BETWEEN THE MEAN SCORES OF THE X AND C GROUPS BASED ON TWO SEPARATE TEN PER CENT SAMPLINGS, TO SHOW THE RELIABILITY OF THE TEN PER CENT SAMPLING

Topic	$M_x - M_c$ for Selection A	$M_x - M_c$ for Selection B	$M_x - M_c$ for Total Selection
Cotton	4.28±.38	3.47±.37	3.88±.26
Irrigation	1.59±.28	2.03±.28	1.82±.19
Bituminous Coal	3.06±.40	2.58±.39	2.82±.28
Iron Ore to Pig Iron	3.83±.50	3.34±.47	3.59±.35
Limestone and Marble	2.20±.70	1.42±.73	1.82±.50
Sand and Clay	8.50±.74	8.26±.70	8.40±.51
Reforestation	1.37±.57	.64±.57	1.00±.40
Planting and Care of Trees	1.09±.55	1.67±.59	1.33±.41

Note: In no case is the difference between A and B differences significant.

parts and the scores on half the questions were correlated with the scores on the other half. The results are shown in Table 28. The first line of this table reads as follows: In the topic Corn the papers of 126 pupils of the X Group were tabulated by the method just described. It was found that the scores on half the questions correlated with the scores on the other half to the extent of .62. The reliability of the entire test on the topic "Corn" was estimated by the Spearman-Brown formula to be .76. In a similar way the reliability of the topic "Iron Ore to Pig Iron" was found to be .81, and on the "New York Water Supply" .74. No attempt has been made to estimate the reliability of the scores on the entire series of Topical Tests taken together. It is undoubtedly considerably greater than that of the individual topics.

Total number of Topical Tests scored. The total number of papers in Geography which were graded was 9053, which is 12.5 per cent of the total number. The total number of papers in General Science which were graded was 4288, or

12.1 per cent of the entire number. The total number of papers graded was 13,341, which is 12.4 per cent of the entire number.

Table 28. The Reliability of Three Topical Tests Measured by the Split-Test Method

Topic	Group	Number of Papers	$r_{\frac{1}{2}\frac{1}{2}}$	r_{11} Spearman-Brown
Corn	X	126	.62	.76
Iron Ore to Pig Iron	C	129	.68	.81
New York Water Supply	X	106	.59	.74

SUMMARY

1. The purpose of the Topical Tests was to measure the attainment of the pupils upon each topic individually by giving them somewhat greater freedom in organizing their answers than objective tests would afford, and by giving them opportunity to some extent to express their answers in other than verbal terms.
2. In form the Topical Tests were of the essay type, the questions falling into two classes, one descriptive and the other explanatory. In the descriptive questions pupils were asked to reproduce by words or by diagrams the appearance of things which they had seen. In the explanatory questions they were asked to explain why certain actions or events occurred as they did. In general the descriptive questions tended to emphasize the direct outcomes, while the explanatory questions tended to emphasize the indirect outcomes of instruction with films.
3. Before any scoring was done the meaning of each question was discussed and the types of answers which should be credited were listed. Preliminary scores on a

number of papers were then compared and points to be noted in the scoring of each question were agreed upon. In the scoring procedure the papers were mixed together and the scorers did not know in any individual case whether the paper was from the X group or from the C group.

4. Something over 4000 of the 35,000 papers in General Science and 9000 of the 72,000 papers in Geography were scored. This represents a little over 12 per cent of the total number of papers submitted. It was impossible to score all of the papers within the time available for work. A minimum of 10 per cent of the pupils was selected from each class in the experiment, the selection being made upon the basis of matching intelligence quotients.
5. On the first six topics 10 per cent of the papers were scored, and on the last four topics 20 per cent of the papers were scored. The agreement between the 10 per cent and the 20 per cent sampling was ample to confirm the reliability of the 10 per cent sampling. The mean scores derived from a sampling of 10 per cent of the papers were not significantly different from the mean scores on the other 10 per cent sampling.
6. An estimate of the reliability of the Topical Tests was arrived at by the split-test method. In the topic "Corn," for example, it was found that the scores on half the questions correlated with the scores on the other half by .62. The correlation of the scores on the entire series of the Topical Tests undoubtedly would be greater than the correlation of the scores on any individual topic.

CHAPTER VI

RESULTS OF THE TOPICAL TESTS

General Science: Comparison of total scores of X and C groups — Comparison by cities — Comparison by topics — Geography: Comparison of total scores of X and C groups — Comparison by cities — Comparison by topics — Summary.

The present chapter is devoted to a general comparison of the attainments of the X and C groups as measured by the Topical Tests. The nature, the method of construction, administration, and scoring of these tests are described in Chapter V. It will be recalled that a separate test was given on each topic and that these tests were administered at the close of the period of instruction on each pair of topics. The scores of the X and C pupils are tabulated for the topics in General Science and the topics in Geography separately. For each series of topics the results are classified first by cities and then by topics.

GENERAL SCIENCE

Comparison of total scores of X and C groups. The results of the Topical Tests in General Science are shown in Tables 29 and 30. Table 29 presents the results classified by cities, and Table 30 presents the results classified by topics. An explanation of Table 29 will serve for all tables of this chapter. In City A there were 225 pupils scored from the X group and 325 from the C group. The greater number of pupils in the C group was a fortuitous circumstance and not the result of deliberate planning, as will be seen from the totals at the bottom of the columns. The numbers of pupils in the two groups in all cities taken together are approximately equal. The mean score of all the papers of those pupils of the X group which were selected for scoring is

18.23. The probable error of this mean is .29. The corresponding mean score of the pupils in the C group is 19.72 and the probable error of this score is .25. The difference between these means is −1.49, with a probable error of .38. This difference is written with a minus sign because the X group made a lower score than did the C group. The standard deviation of the scores of the X and C groups together is 6.75. The difference between the means is 22 per cent of this standard deviation. This per cent is written again with a minus sign because it represents an inferiority on the part of the X group.

If we examine the returns from City F we observe that the difference is in the other direction. The mean score of the X

TABLE 29. COMPARISON OF THE MEAN SCORES OF THE X AND C GROUPS, ON THE TOPICAL TESTS IN GENERAL SCIENCE, CLASSIFIED BY CITIES

City	Number of Cases		Means and Probable Errors		$M_x - M_c$	S.D.'s of X and C Groups Together	Ratios of Differences to S.D.'s
	X	C	X	C			
A	225	325	18.23±.29	19.72±.25	−1.49±.38	6.75	−.221
B	105	117	21.74±.48	20.33±.41	1.41±.63	6.96	.203
C	384	469	22.70±.29	18.19±.24	4.51±.38	8.40	.537
D	347	337	15.52±.25	9.85±.22	5.67±.33	7.08	.801
E	190	187	17.55±.34	24.17±.37	−6.62±.50	8.01	−.826
F	208	214	26.61±.36	19.24±.35	6.37±.50	8.49	.869
G	101	94	25.95±.47	18.74±.66	7.21±.81	9.06	.796
H	53	53	18.38±.62	20.64±.60	−2.26±.86	6.69	−.338
I	188	86	10.13±.31	8.85±.45	1.28±.55	6.33	.202
J	189	206	22.78±.42	19.64±.32	3.14±.53	7.89	.398
K	43	41	21.02±.62	20.46±.72	.56±.95	6.42	.087
L	60	65	17.70±.53	14.89±.57	2.81±.78	6.63	.424
Totals and Means	2093	2194	19.65±.13	17.66±.12	1.99±.18	8.58	.232

group is 26.61 and the mean score of the C group is 19.24. The difference is 6.37 in favor of the X group. The standard deviation is 8.49 and the superiority of the X group is 87 per cent of the standard deviation.

Comparative scores of the X and C groups in all cities taken together are given in the bottom line of the table. The average score of the X group is 19.65 with the small probable error of .13. The average score of the C group is 17.66 with the small probable error of .12. The difference is 1.99 points in favor of the X group, and the probable error of .18 is less than one tenth of the difference. The standard deviation of all the scores is 8.58. The X group is, therefore, superior to the C group by 23.2 per cent of the standard deviation. In view of the small probable error of the difference, this is statistically a very significant difference.

Comparisons by cities. An inspection of the results from the individual cities indicates that the X group is superior in nine out of the twelve and the C group is superior in three out of the twelve. In one of these three cities the number of pupils who took part in the experiment is small. The results from this city are, therefore, statistically less significant than are the results from the majority of the cities. Aside from this broad distinction between cities in which the X group and the C group are superior, there are variations in the degree of the superiority of the X group. This variation is to be expected. The experiment was planned to include a large number of cities in order that unpredictable variations might be ironed out in the general results. A further analysis of the variations among cities will be deferred until Chapter VII, in which the results of the Comprehensive and the Topical Tests are compared.

Comparison by topics. The comparison between the scores of the X and C groups on individual topics is made in Table 30. This table is constructed on the same plan as

Table 29. Thus the scores from all cities on the topic "Hot Air Heating" yield an average of 16.84 for the X group and 18.57 for the C group, a difference of .224 standard deviation in favor of the C group. On the other hand the topic "Sand and Clay" shows a difference of 8.40 points in favor of the X group. This is .843 standard deviation in favor of the classes which saw the films. The averages shown at the bottom of the table are, of course, identical with the averages of Table 29.

TABLE 30. COMPARISON OF THE MEAN SCORES ON THE TOPICAL TESTS IN GENERAL SCIENCE OF THE X AND C GROUPS, CLASSIFIED BY TOPICS

Topics	Number of Cases		Means and Probable Errors		$M_x - M_c$	S.D.'s of X and C Groups Together	Ratios of Differences to S.D.'s
	X	C	X	C			
Hot Air Heating	168	174	16.84±.40	18.57±.40	−1.73±.57	7.74	−.224
Atmospheric Pressure	167	171	13.75±.37	14.74±.40	−.99±.54	7.50	−.132
Compressed Air	166	176	16.56±.40	13.29±.35	3.27±.53	7.44	.440
Water Cycle	173	179	16.26±.44	17.78±.46	−1.52±.64	8.88	−.171
New York Water Supply	178	172	20.10±.41	20.26±.43	−.16±.59	8.22	−.019
Purifying Water	180	180	21.17±.45	15.92±.38	5.25±.59	8.70	.603
Limestone and Marble	285	302	18.93±.38	17.11±.33	1.82±.50	9.06	.201
Sand and Clay	280	300	24.07±.40	15.67±.32	8.40±.51	9.96	.843
Reforestation	242	270	21.62±.27	20.62±.30	1.00±.40	6.78	.147
Planting and Care of Trees	254	270	22.39±.28	21.06±.30	1.33±.41	7.02	.189
Totals and Means	2093	2194	19.65±.13	17.66±.12	1.99±.18	8.58	.232

It will be seen that in six of the ten topics the X group makes a superior score. In three of the topics the superiority is very large. In four of the topics there is a slight superiority in favor of the C group.

It must be kept in mind in interpreting the comparative scores of the X and C groups in General Science that the inferiority of the X group in intelligence and in initial knowledge of the subjects of instruction constituted a handicap for the pupils of this group. This difference is discussed at length in Chapter III, and the details will not be repeated here. It is, however, to be taken into account in interpreting both the general comparison of the two groups and the comparisons by cities and by topics. These comparisons are based upon final scores rather than upon gains. If they

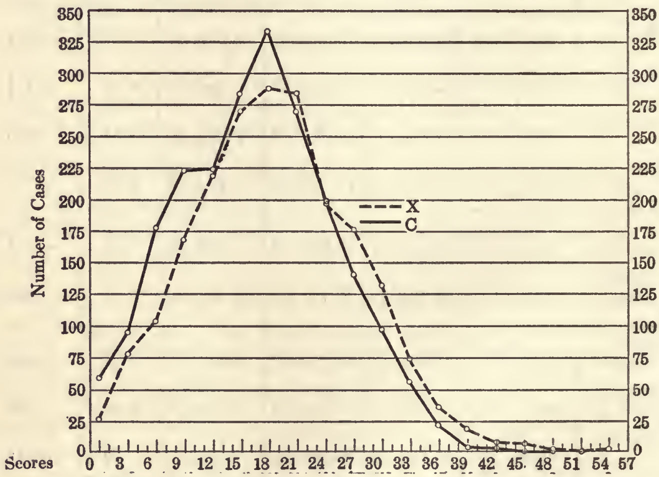

CHART III. FREQUENCY POLYGONS SHOWING FORM OF DISTRIBUTIONS OF TOTAL TOPICAL TEST SCORES IN GENERAL SCIENCE OF ALL X AND ALL C STUDENTS IN ALL CITIES TOGETHER

The dash-line curve shows graphically the distribution of scores of 2093 X students, and the solid-line curve of 2194 C students. $M_x = 19.65$; $M_c = 17.66$; $S.D._{x+c} = 8.58$; $(M_x - M_c) \div S.D. = 23.2\%$.

had been based upon gains, as was the case with Comprehensive Test C2, we may hazard the estimate that the X group would have shown greater superiority on the whole, and a superiority in a larger number of cities, and upon a larger number of topics.

GEOGRAPHY

Comparison of total scores of X and C groups. The comparison of the attainments of the X and C groups in Geography is shown in Tables 31 and 32. As before, the results are classified by cities in the first table and by topics in the second table. Since the tables are constructed in the same way as the preceding tables, we may proceed at once to the analysis of the results. The averages shown at the bottom of these tables indicate that the X groups as a whole made an average score of 17.50 with a probable error of .08, while the C group made an average score of 15.13, with a probable error of .08. The average of the X group is superior to that of the C group by 2.37 points, and the probable error is .11 or less than one twentieth of the difference. This difference is .293 of the standard deviation, or nearly thirty per cent.

On the face of the returns, then, the X pupils in Geography excelled the C pupils by a larger margin than in General Science. These results correspond with the findings of the Comprehensive Tests. Whether this means that the films in Geography are relatively more effective than those in General Science is uncertain. The difference between the findings on Science and Geography from the Topical Tests might be explained satisfactorily by the fact that the X students in General Science suffered from a greater initial handicap than did those in Geography. It is difficult to see how the initial achievement handicap would greatly affect the gains measured by Comprehensive Test C2, but

TABLE 31. COMPARISON OF THE MEAN SCORES ON THE TOPICAL TESTS IN GEOGRAPHY OF THE X AND C GROUPS, CLASSIFIED BY CITIES

City	Number of Cases		Means and Probable Errors		$M_x - M_c$	S.D.'s of X and C Groups Together	Ratios of Differences to S.D.'s
	X	C	X	C			
A	604	595	15.82±.20	14.10±.20	1.72±.28	7.41	.232
B	352	333	20.47±.30	18.76±.34	1.71±.45	8.88	.193
C	466	477	20.94±.23	17.94±.23	3.00±.33	7.62	.394
D	377	311	14.68±.24	10.33±.22	4.35±.33	6.81	.639
E	611	531	20.17±.24	18.90±.21	1.27±.32	8.10	.157
F	314	306	20.41±.31	19.73±.29	.68±.42	7.80	.087
G	402	420	16.88±.26	15.38±.24	1.50±.35	7.53	.199
H	142	190	15.18±.39	11.63±.36	3.55±.53	7.29	.487
I	173	170	21.05±.50	15.31±.33	5.74±.60	8.76	.655
J	244	266	14.75±.32	13.27±.27	1.48±.42	6.99	.212
K	136	122	15.07±.43	12.24±.32	2.83±.54	6.60	.429
L	776	735	14.69±.18	11.76±.16	2.93±.24	7.11	.412
Totals and Means	4597	4456	17.50±.08	15.13±.08	2.37±.11	8.10	.293

the handicap of the X group in General Science was not merely an initial inferiority in achievement, but also a substantial inferiority in average intelligence test scores. Moreover, it is not at all certain whether we should expect pupils who make a lower initial score to gain more than pupils who make a higher initial score. At any rate we should not expect the differences to be large. All things considered, we are led to suspect that there may be some difference in the effectiveness of the two series of films, but we feel that this conclusion must be held quite tentatively.

Comparison by cities. A comparison of the results on the various cities indicates that the X pupils in Geography ex-

celled the C pupils in every city. This fact gives strong confirmation to the general findings as expressed in the average of all cities together. There are, to be sure, variations in

TABLE 32. COMPARISON OF THE MEAN SCORES ON THE TOPICAL TESTS IN GEOGRAPHY OF THE X AND C GROUPS, CLASSIFIED BY TOPICS

Topic	Number of Cases		Means and Probable Errors		$M_x - M_c$	S.D.'s of X and C Groups Together	Ratios of Differences to S.D.'s
	X	C	X	C			
New England Fisheries	350	325	26.04±.34	22.69±.32	3.35±.47	9.15	.366
Wisconsin Dairies	352	334	13.66±.21	14.00±.22	−.34±.30	5.85	−.058
Wheat	360	342	12.95±.22	11.58±.26	1.37±.34	6.72	.204
From Wheat to Bread	367	349	14.89±.26	13.43±.24	1.46±.35	7.05	.207
Cattle	372	346	15.19±.22	13.49±.23	1.70±.32	6.39	.266
Corn	369	344	18.92±.26	16.82±.28	2.10±.38	7.62	.276
Cotton Growing	611	606	21.52±.19	17.64±.18	3.88±.26	7.14	.543
Irrigation	626	627	11.96±.14	10.14±.13	1.82±.19	5.16	.353
Bituminous Coal	615	600	18.47±.21	15.65±.19	2.82±.28	7.41	.381
Iron Ore to Pig Iron	575	583	20.45±.24	16.86±.25	3.59±.35	8.88	.404
Totals and Means	4597	4456	17.50±.08	15.13±.08	2.37±.11	8.10	.293

the degree of superiority among the different cities, as in the case of General Science. We shall defer the discussion of these variations until Chapter VII.

Comparison by topics. An inspection of Table 32 indicates that the X group was superior on all but one of the Geography topics. On this one topic the difference is less than one fifth of the general average difference. It is so small as to be negligible. This again is confirmatory evi-

dence of the superiority of the instruction in Geography which included the use of the motion picture films.

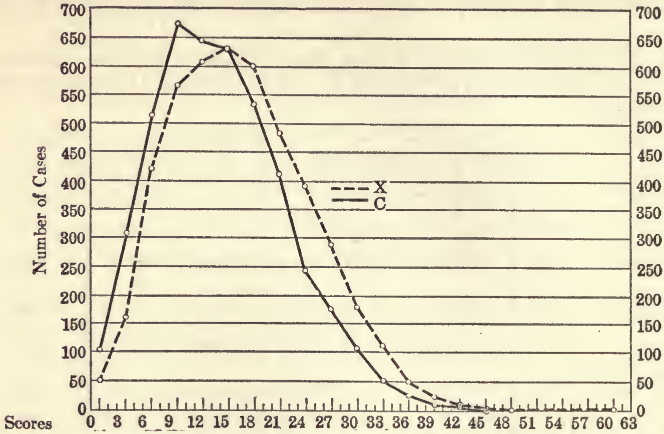

CHART IV. FREQUENCY POLYGONS SHOWING FORM OF DISTRIBUTIONS OF TOTAL TOPICAL TEST SCORES IN GEOGRAPHY OF ALL X AND ALL C STUDENTS IN ALL CITIES TOGETHER

The dash-line curve shows graphically the distribution of scores of 4597 X students, and the solid-line curve of 4456 C students. $M_x=17.50$; $M_c=15.13$; $S.D._{x+c}=8.10$; $(M_x-M_c)\div S.D.=29.3\%$.

SUMMARY

1. In General Science the pupils of the X group excelled the pupils of the C group, as measured by the Topical Tests, to the extent of 1.99 points. This difference is 23.2 per cent of the standard deviation, and 11.0 per cent of the average of the scores of both X and C groups.
2. In Geography the pupils of the X group excelled the pupils of the C group, as measured by the Topical Tests, to the extent of 2.37 points. This difference is 29.3 per cent of the standard deviation, and 15 per cent of the average of the scores of both X and C groups.

3. In General Science the X group excelled the C group in nine of the twelve cities.
4. In Geography the X group excelled the C group in all of the twelve cities.
5. When the scores are tabulated by topics, the X classes in General Science excel the C classes on six of the ten topics.
6. In Geography the X classes excel the C classes on nine of the ten topics.

CHAPTER VII

AGREEMENT BETWEEN RESULTS OF COMPREHENSIVE AND TOPICAL TESTS

Total Comparisons — Comparison by Cities: General Science — Final Test C3 — Geography — Final Test C3 — Comparisons by Topics: General Science — Geography — Relative effectiveness of films — City-topic comparisons — Summary.

TOTAL COMPARISONS

The comparison between the test performances of the X and C groups has been made in the discussion of each of the two series of tests separately (Chapters IV and VI). The purpose of the present chapter is to compare the indications of the two independent series of tests for the entire X and C groups as well as for individual city groups, and for the entire course of study as well as for individual topics. This comparison will throw further light on the reliability of the conclusions drawn from each of the two series of tests, and will also serve as a convenient summary of their major indications.

Table 33 shows that the two series of tests agree not only in indicating that the X group is substantially superior to the C group, but also agree very closely as to the degree of that superiority. According to both series of tests the superiority of the X group is greater in Geography than in General Science, but we must remember the greater initial achievement and intelligence handicaps of the X group in General Science. Such close agreement between the two series of tests is remarkable in view of the differences between the character of the tests and the complete independence of one series from the other.

In reality, Table 33 summarizes data from three different

Table 33. Showing Agreement Between Indications of Comprehensive and Topical Tests for All Twelve Cities Together, and for the Entire Courses of Study in General Science and in Geography

The differences between X and C mean gains and between X and C mean scores are expressed as per cents of the S.D.'s of the Scores of X and C students treated as one group, and also as per cents of the Mean Gain and of the Mean Scores of the C groups. The relationships summarized here are taken from Tables 14, 15, and 16 in Chapter IV, and from Tables 29 and 31 in Chapter VI.

	Comprehensive Tests		Topical Tests
	Initial C2 and Final C2, Gains	C3	
	$(G_x - G_c) \div S.D._{x+c}$	$(M_x - M_c) \div S.D._{x+c}$	$(M_x - M_c) \div S.D._{x+c}$
General Science	+14.5% S.D.	+78.2% S.D.	+23.2% S.D.
Geography	+33.2% S.D.	+84.5% S.D.	+29.3% S.D.
	$(G_x - G_c) \div G_c$	$(M_x - M_c) \div M_c$	$(M_x - M_c) \div M_c$
General Science	+11.7% G_c	+12.5% M_c	+11.3% M_c
Geography	+19.8% G_c	+17.0% M_c	+15.7% M_c

types of tests, since the Comprehensive Tests are of two kinds, one measuring gains along the line of usual school aims, and the other measuring end-achievement relating especially to concrete objects, actions, and processes. The only notable difference between the indications of these three types of tests is that the degree of superiority on Final Comprehensive Test C3, when expressed in terms of the standard deviation, is very much larger than the degree of X superiority indicated by the other tests. All things considered, it seems safe to say that the superiority of the X group on Test C3 is greater and more consistent (Table 16) than on the other tests; but the difference is probably not so great as it appears at first sight. When we express the X superiority on Test C3 as a fraction of the Control Mean Score, it appears to be only slightly greater than the X superiority on the Topical Tests expressed as a fraction of the Control Mean. (Table 33.)

Attention is called to this difference as a warning against a too hasty acceptance of the larger or the smaller measure of X superiority on Test C3. The average scores on Test C3 are relatively high for both X and C groups in both General Science and Geography, and the standard deviations are small; these facts account in part at least for the apparently large superiority when the X − C differences are expressed in terms of the standard deviation, and for the apparently moderate superiority when expressed in terms of Control Mean Score.

It is not the province of this report to develop all the technical considerations that would be required to resolve these differences in exact and comparable units. Our purpose is to show whether classroom films make a measurable contribution. None of these differences minimizes the significance of the fact that all our test data agree in indicating that the X groups, in spite of large handicaps in terms of lower intelligence test scores and lower initial achievement test scores, are substantially superior to the C groups at the end of the experiment.

COMPARISONS BY CITIES

General Science. We have already learned from Tables 14, 15, 29, and 31 that the number of cities in which the X group was superior to the C group is about the same according to both series of tests. Since in this chapter we are studying the agreement between two series of tests, it is important to learn whether the two series of tests indicate superiority for the X group in the same or in different cities.

Chart 5 shows a remarkably close agreement between the Comprehensive and Topical Tests in ranking the twelve cities according to degree of superiority of the X over the C group in General Science. The agreement is especially noteworthy when we consider the differences between the

CHART V. SHOWING AGREEMENT BETWEEN COMPREHENSIVE AND TOPICA
OF SUPERIORITY OF THE X STUDENTS

The data for this Chart are taken from Table 14 in Chapter IV and from Table 29 in Ch
indices so that interested readers may compare the indic

GENERAL

Comprehensive Tests C2 Gains		Ge					
		.868	.801	.796	.537	.424	.398
$G_x - G_c$	Ranks	1	2	3	4	5	6
8.10	1	F					
5.50	2			G			
5.10	3				C		
2.80	4		D				
1.80	5					L	
1.40	6						
1.00	7						
0.50	8						
−0.20	9						J
−1.70	10						
−2.00	11						
−4.60	12						
Number of Topical Test papers divided by 10 to get number of papers scored for each city.	X C	208 214	347 337	101 194	384 469	60 65	189 206

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R THE C STUDENTS IN GENERAL SCIENCE

VI. The degree of superiority is indicated in the lines above and to the left of the rank
s of the two sets of tests in terms more exact than rankings.

ENCE TOPICS

Science Topical Test: $(M_x - M_c) \div S.D._{x+c}$

.203	.202	.087	−.221	−.338	−.826	No. of Cases	
7	8	9	10	11	12	X	C
						157	157
						36	50
						235	242
						212	169
						36	45
	I					134	78
			A			144	207
B						71	79
						125	137
					E	124	125
		K				31	25
				H		35	31
105	188	43	225	153	190		
117	186	41	325	53	187		

tests, and the fact that the Topical Test results are based only upon 10 per cent or 20 per cent samplings of the papers for each topic. It is to be remembered, however, that, as shown in Tables 25–27a, inclusive, the average of a 10 per cent sampling is a highly stable measure. The Comprehensive Test results are based on returns from all the children in each city who took Initial and Final Test C2. The numbers of cases for each city are indicated in the last column at the right of the chart. The numbers in the lowest row of the chart show the approximate number of Topical Test papers read for the cities indicated. Thus for City F, 208 papers were read for X and about the same number for C students; but only about 20 papers were read on each of the first six topics and 40 papers on each of the last four topics. The cities are ranked by the Topical Tests according to excess of X over C mean scores, expressed in terms of the standard deviation of the Topical Test scores of all X and C students treated as one group; and they are ranked by the Comprehensive Tests according to excess of X mean gain over C mean gain.

City F is given highest rank by both series of tests. If we were concerned only with agreement as to whether the X group or the C group is superior, we might say at once that the X group is superior in seven cities on both tests and that the C group is superior in two cities on both tests. But this statement, without the additional evidence of Chart 5, would not do full justice to the agreement between the two series of tests, because it does not describe the close agreement throughout the whole range of X superiority, and because it fails to indicate the really close agreement on Cities A, J, and K. A shift of only one step would put each of these three cities in the same category on both tests. City K had only 31 and 26 students in the X and C groups, respectively, who took the Initial and Final Test C2. A small

disagreement on such a small class cannot be considered significant.

The two tests clearly agree in indicating superiority of the C groups in Cities E and H. These two cities are such clear-cut exceptions to the preponderant evidence in favor of the X groups that they obviously invite further study. Our analysis of the conditions in Cities E and H convinces us that the undoubted superiority of the C groups in them does not in any sense constitute evidence against the validity of the conclusion that the classroom film gives superior results when the general conditions of instruction are approximately equal.

In City E the average intelligence score of the X group was 32.2 per cent of the standard deviation below that of the C group, and the average score of the X group on Initial Test C2 in General Science was about 80 per cent of the standard deviation below the average of the C group. The X group in this city is then slightly more handicapped than are the X groups as a whole at the outset of the experiment. This handicap is mentioned only as a contributing factor to the superiority of the C group at the end.

City E was highly exceptional in the attitude of the X teacher toward the experiment. This teacher's answers to the questionnaire and his reports on the conduct of his classes are more than enough to account for the inferiority of the X group, especially in view of the fact that the teachers of the C classes in City E were heartily in sympathy with the experiment and exerted themselves energetically to make a good showing against the film classes. No reflection on this teacher is intended here; nor would any be justified. All the facts available to us are given in Chapters VIII and IX and will not be anticipated in detail here. Suffice it to say that he honestly disapproved of the organization of the experiment, and complained against being compelled to

interrupt his usual classroom procedure in favor of the curriculum and procedure prescribed by the Experimental Teachers' Guide. The result was that the X classes had no real chance in competition with classes whose teachers adhered rigorously and energetically to the Study Guides on which the competitive tests were based. In view of the initial handicaps of the X group, and considering the attitude and reports of this teacher as set forth in Chapters VIII and IX, the wonder is that the superiority of the C group was not greater.

In City H there were only about forty students in the X and C groups, respectively. Both groups were below the average at the beginning, and both groups made larger gains than were made by any group in any other city. The X gain was one and two thirds times the average gain of all groups in all cities, and the C gain was twice that average gain. Intelligence scores of the C students were not made available, but from the fact that the C class was only slightly superior to the X class on the Initial Test in General Science we judge that the two groups were very nearly equal in intellectual ability. The reports of the X and C teachers confirm the suspicion that very unusual circumstances attended the instruction of these two classes. An examination of these reports, presented in parallel columns in Chapter IX, indicates that both teachers are above average, but that the C class had richer instruction under great pressure, which enabled it to outdistance the X class. To avoid repetition, the reader is invited at this point to read the X and C teachers' reports in Chapter IX, pp. 179–182.

The fact that both series of tests indicate that the C groups in Cities E and H are superior to the X groups leads to two important conclusions. The first is that films must be used properly if their values are to be fully realized. This conclusion, of course, could have been stated in advance, for

it is true of any device; but we consider the results in Cities E and H to be too good an opportunity to be ignored for emphasizing a healthy warning. The films simply cannot take the place of a teacher alive with his subject and using energetically every available pedagogical device. Nor are they intended to do that, however closely they may enable a mediocre class under unfavorable classroom conditions to approximate the achievement of a non-film class of superior students under an excellent teacher.

The second conclusion is that both sets of tests are highly impartial. Without seeing the test results, any one acquainted with the other data on Cities E and H (see Tables 14 and 29, and Chapters VIII and IX) would easily conclude that the C classes would almost necessarily outdistance the X classes. The tests clearly and unambiguously display the superiority of the C classes in these two cities.

Final Test C3. According to the results of Test C3 in General Science the X group is superior in all cities. Reference to Tables 16 and 29 will show that the agreement between this part of the Comprehensive Tests and the Topical Tests is also very close. City E is ranked lowest by both tests. The only notable disagreements are that Cities H and A are given highest and third highest ranks by Test C3, as against eleventh and tenth ranks by the Topical Tests. The disagreement on City H must be considered in the light of the facts regarding City H reviewed above. The teachers' reports from Cities A and H indicate that the X teachers leaned heavily on the films, and it therefore seems plausible that the X students would excel especially on Test C3, which emphasizes knowledge of concrete objects and processes. The agreement in ranking the other ten of the twelve cities is close, and reënforces the general conclusion that we may accept the indications of both series of tests with confidence.

Chart VI. Showing Agreement Between Comprehensive and Topica
of Superiority of the X Student

The data for this Chart are taken from Table 15 in Ch

Geogra

Comprehensive Tests C2 Gains		G					
		.655	.639	.487	.429	.412	.394
$G_x - G_c$	Ranks	1	2	3	4	5	6
10.3	1	I					
10.2	2			H			
6.5	3						
5.8	4						C
4.8	5					L	
4.6	6		D				
3.7	7						
3.5	8						
2.9	9						
0.8	10						
0.4	11				K		
−0.3	12						
Number of Topical Test papers divided by 10 to get number of papers scored for each city	X C	173 170	377 311	142 190	136 122	776 735	466 477

ESTS IN RANKING THE TWELVE COÖPERATING CITIES ACCORDING TO DEGREE
VER THE C STUDENTS IN GEOGRAPHY

IV and from Table 31 in Chapter VI. (See Chart IV.)

TOPICS

phy Topical Test: $(M_x - M_c) \div S.D._{x+c}$

.232	.212	.199	.193	.157	.052	No. of Cases	
7	8	9	10	11	12	X	C
						104	103
						83	111
				E		380	243
						279	297
						514	470
						235	202
A						390	369
					F	254	194
			B			229	198
	J					153	174
						87	83
		G				237	238
604 595	244 266	402 420	352 333	611 531	314 306		

Geography. Chart VI shows that the agreement between the Comprehensive and Topical Tests in ranking the cities according to superiority of the X group in Geography is close, although not so close as in the case of General Science. The agreement on eight of the twelve cities is almost perfect, and is close in another city (F), which is ranked eighth by one and twelfth by the other series of tests. The X groups are superior on both tests in ten of the twelve cities, and the X and C groups are practically equal in two cities according to one or the other of the two series of tests — Cities F and G. The only marked disagreements are as to the degree of superiority of the X groups in Cities D, E, and K.

In City D the very large superiority of the X students according to the Topical Tests is largely explained by the very low scores of the C group. Large numbers of the C students in City D did not even attempt to answer the Topical Test questions; on several of the topics they wrote, "We have not studied this question yet." The reports from some of the C teachers in this city mentioned the fact that an epidemic had interrupted the work of the C classes in some of the schools. These disturbances, together with the other factors mentioned, help to explain the disagreement of the two series of tests in City D.

In Cities E and K we have found nothing unusual to explain the slight disagreements between the two series of tests. These disagreements are to be balanced against the almost perfect agreement on eight of the twelve cities, and do not countervail the prevailing evidence in favor of the reliability of the tests in indicating the superiority of the X over the C groups.

Final Test C3. Comparison of Table 16 with Table 31 will show that Final Test C3 also agrees fairly well with the Topical Tests in ranking the cities according to superiority of the X groups in Geography. In all cities the X superior-

ity on Final Test C3 is so great that small disagreements are exaggerated.

In these comparisons the reliability of the two series of tests has been put to a severe test. The agreement between them is very close, and the disagreements are small, and for the most part have been explained by reference to concrete conditions. Much larger disagreements might be observed without impairing the weight of the evidence supporting our confidence in the test indications.

TABLE 34. SHOWING THE PER CENT CORRECT RESPONSES ON QUESTIONS BY TOPICS ON INITIAL COMPREHENSIVE TEST C2 AS COMPARED WITH PER CENT CORRECT RESPONSES ON TOPICS IN FINAL COMPREHENSIVE TEST C2.

GENERAL SCIENCE
1340 X and 1346 C Students

Topics	Questions Nos.	Groups	Initial Test C2	Final Test C2	Per cent Gain	Difference in Favor of the X Group
Hot Air Heating	1–10	X C	60.6 70.9	73.9 82.0	13.3 11.1	+2.2
Atmospheric Pressure	11–20	X C	40.3 46.9	56.5 64.3	16.2 17.4	−1.2
Compressed Air	21–30	X C	40.0 48.2	59.4 63.8	19.4 15.6	+3.8
Water Cycle	31–40	X C	38.4 45.5	53.8 59.2	15.4 13.7	+1.7
New York Water Supply	41–50	X C	27.6 30.9	38.2 46.4	10.6 15.5	−4.9
Purifying Water	51–60	X C	43.1 53.3	68.2 72.2	25.1 18.9	+6.2
Limestone and Marble	61–70	X C	41.9 49.3	66.0 75.7	24.1 26.4	−2.3
Sand and Clay	71–80	X C	31.7 36.0	45.8 48.8	14.1 12.8	+1.3
Reforestation	81–90	X C	34.1 38.4	47.2 52.1	13.1 13.7	−0.6
Planting and Care of Trees	91–100	X C	49.2 54.8	58.0 65.9	8.8 11.1	−2.3

TABLE 34 (*continued*).

GEOGRAPHY

2844 X and 2684 C Students

Topics	Questions Nos.	Groups	Initial Test C2	Final Test C2	Per cent Gain	Difference in Favor of the X Group
New England Fisheries	1–10	X	44.3	72.6	28.3	+4.4
		C	48.2	72.1	23.9	
Wisconsin Dairies	11–20	X	49.4	76.4	27.0	+4.7
		C	50.6	72.9	22.3	
Wheat	21–30	X	30.4	45.1	14.7	−1.9
		C	29.7	46.3	16.6	
From Wheat to Bread	31–40	X	22.2	32.3	10.1	+1.0
		C	17.7	26.8	9.1	
Cattle	41–50	X	38.3	66.1	27.8	+3.0
		C	38.8	63.6	24.8	
Corn	51–60	X	38.6	62.9	24.3	+0.9
		C	39.1	62.5	23.4	
Cotton	61–70	X	50.5	66.6	16.1	−0.8
		C	49.7	66.6	16.9	
Irrigation	71–80	X	28.2	50.2	22.0	+5.0
		C	30.3	47.3	17.0	
Bituminous Coal	81–90	X	39.5	64.9	25.4	+7.5
		C	42.3	60.2	17.9	
Iron Ore to Pig Iron	91–100	X	36.4	67.3	30.9	+5.0
		C	36.5	62.4	25.9	

COMPARISONS BY TOPICS

In comparing the Comprehensive and Topical Test results on the individual topics in the courses of study in General Science and Geography, the reader should recall that there were only ten objectively scored questions on each topic in the Comprehensive Tests and only about ten subjectively scored questions in the Topical Tests. Moreover, the Topical Test results are based only upon 10 per cent or 20 per cent samplings of all the papers received from each city on each topic. Notwithstanding the fact that the reliability of scores based on such small numbers of questions is not very great, we find such a considerable agreement be-

tween the two series of tests that our confidence in both is confirmed.

The Topical Test results on the ten General Science topics have been presented in Table 30, and on the ten Geography topics in Table 32. Table 34 shows the X and C gains on the General Science and Geography topics as measured by the C2 tests in General Science and Geography. These three tables furnish the data for Charts VII and VIII.

The results of Final Tests C3 would be especially interesting for the comparisons by topics; but the results of these tests have been tabulated by topics for only four of the twelve cities, and it seems unwise to delay this report until the tabulations can be completed for all twelve cities. They will therefore be reserved for a later study.

General Science. Chart VII shows that with only one or two exceptions the Comprehensive and Topical Tests agree fairly closely in ranking the ten General Science topics according to degree of superiority of the X group. The rankings by the two series of tests are almost identical for five of the topics, and are fairly close on four others. The largest disagreement is on the topic "Hot Air Heating," which is given third highest rank by the Comprehensive and lowest rank by the Topical Tests. These disagreements between such small fractions of the total Comprehensive and Topical Tests are small as compared with the general agreement on a majority of topics. Indeed, the agreements between test-fractions as limited as these are nothing short of remarkable, especially in view of the small samplings used in the Topical Tests.

Geography. Chart VIII shows that the agreement between the Comprehensive and Topical Tests is almost perfect in ranking eight of the ten Geography topics. There are only two disagreements, a moderate one with regard to the topic "Wisconsin Dairies," and a large disagreement on the topic

Chart VII. Showing Agreement Between Comprehensive and Topical Tests in Ranking Film Topics in the Order of Superiority of the X Group over the C Group in General Science

The data for this Chart are taken from Tables 30 and 34. The Comprehensive Test results are based on returns from 1340 X and 1346 C students. The Topical Test results are based on the numbers of cases indicated in the last row of the Chart. (See Chart III.)

General Science Topics

Comprehensive Tests C2 Gains		General Science Topical Test: $(M_x - M_c) \div S.D._{x+c}$									
		0.843	.603	.440	.201	.189	.147	.019	−.132	−.171	−.224
$G_x - G_c$	Rank	1	2	3	4	5	6	7	8	9	10
6.2	1		Purifying Water								
3.8	2			Compressed Air							
2.2	3										Hot Air Heat.
1.7	4									Water Cycle	
1.3	5	Sand and Clay									
−0.6	6						Reforestation				
−1.2	7								Atmos. Pressure		
−2.3	8				Lime and Marble						
−2.31	9					Plant. Care of Trees					
−5.0	10							N.Y. Water Sup.			
N	X C	280 300	180 180	166 176	285 302	254 270	242 270	178 172	167 171	173 179	168 174

Chart VIII. Showing Agreement Between Comprehensive and Topical Tests in Ranking Film Topics in the Order of Superiority of the X Group over the C Group in Geography

The data of this Chart are taken from Tables 32 and 36. The Comprehensive Test results are based on returns from 2844 X and 2684 C students. The Topical Test results are based on the numbers of cases indicated in the last row of the Chart. (See Chart IV.)

Geography Topics

Comprehensive Tests C2 Gains		Geography Topical Test: $(M_x - M_c) \div S.D._{x+c}$									
		.543	.404	.381	.366	.353	.276	.266	.207	.204	−.058
$G_x - G_c$	Rank	1	2	3	4	5	6	7	8	9	10
7.5	1			Bituminous Coal							
5.1	2		Iron Ore								
5.0	3					Irrigation					
4.7	4										Wis. Dairies
4.4	5				Cod						
3.0	6							Cattle			
1.0	7								Bread		
0.9	8						Corn				
−0.8	9	Cotton									
−1.9	10									Wheat	
N	X C	611 606	575 583	615 600	350 325	626 627	369 344	372 346	367 349	360 342	352 334

"Cotton." In view of the limitations of the tests on single topics and in view of the small samplings used in the Topical Tests, two disagreements of this sort are not unexpected. The remarkable thing is that the agreement should be so close on eight of the ten topics. Such close agreement between small fractions of two wholly independent series of tests produces confidence not only in the total tests, but in the topical fractions of them.

Relative effectiveness of films. Charts VII and VIII furnish a strong temptation to speculate on the relative effectiveness of the individual films in General Science and Geography, but with the data at hand we can do little beyond speculating on these tempting questions. In spite of the striking agreement between the two series of tests in ranking the topics in the order of degree of superiority of the X groups, the fact remains that our tests cannot be taken as sufficiently exhaustive measures of the contributions of the individual films to be made the basis for conclusive comparisons between the merits of the several films in each course of study. These tests were designed to show the relative achievements in defined courses of study of two groups of students, one having the aid of the films and the other not having such aid. All the evidence available indicates that the tests are adequate to measure the relative attainments of these two groups in a highly reliable and valid way, but it is unthinkable that 15 or 20 questions of whatever type could furnish a sampling of the rich and variegated direct and marginal offerings of the films used in this experiment which would be adequate for judging their total relative merits. All that we can do, therefore, is to suggest this problem as exceedingly worthy of serious and large-scale research; and, perhaps, to eliminate one or two possible causes of the apparent differences in effectiveness of the films indicated in Charts VII and VIII.

In Chart VII the three films "Purifying Water," "Compressed Air," and "Sand and Clay" are ranked very high and the film "New York Water Supply" is ranked very low by both series of tests.

(*a*) It is conceivable that the order in which the films occur in the teaching program may influence their effectiveness. The films coming late in the schedule after the teachers have become accustomed to the technique of using them might conceivably be used more skillfully and effectively than those coming early. This factor evidently does not account for the differences which appear in Chart VII, because the three films which appear to be most effective according to the test results were well distributed as to the order in which they were used in the teaching schedule, namely, third, sixth, and eighth. Moreover, the film which is least effective according to our tests was the fifth on the teaching schedule, exactly at the middle of the series of ten films.

(*b*) It is conceivable that the differences may be due to the general nature of the topic with which the film deals. This theory, however, does not seem to have any validity so far as we can observe within the range of topics included in the ten films. For example, the topic "Purifying Water," which is the most effective of the ten films in General Science, is very similar to the topic "New York Water Supply," which is the least effective according to both series of tests. Also the topic "Sand and Clay" is similar in its general character to the topic "Limestone and Marble," but the former is very effective and the latter only moderately effective according to the tests.

(*c*) The most plausible suggestion is that the apparent differences are due to the limitations of the tests themselves and are therefore not general differences in effectiveness, but spurious artifacts. The fact that the two independent series of tests agree in the classification of the topics in Charts VII

and VIII indicates that the films may be correctly ranked with respect to the types of achievement measured by the two series of tests. But whatever is measured by ten or fifteen questions, however carefully they may be constructed, and whatever may be their content, cannot be identified with the concept of total educational effectiveness appropriate to any one of the films used in this experiment. The agreement between the two series of tests indicates that the ranking of the films is reliable so far as the achievement measured by the test questions is concerned, but even this agreement cannot be made the basis for conclusively judging the *total* educational effectiveness of so rich an experience as one of the films used in this experiment.

City-topic comparisons. Returning to the argument of this chapter, there is still a minor comparison that may be made between the results of the Comprehensive and Topical Tests. Tables 35 and 36 show the relative standing of the X and C groups in each city on each topic on the basis of the Topical Tests. Tables 37 and 38, with which we close the present chapter, show the relative gains of the X and C groups in each city on each topic on the basis of Initial and Final Tests C2. In three of these four tables 120 comparisons between X and C groups are possible, and in the fourth 118 comparisons may be made. According to the Topical Tests (Tables 35 and 36) the X group is superior to the C group in 62 per cent of the 118 comparisons in General Science, and in 81 per cent of the 120 comparisons in Geography. According to the Comprehensive Tests (Tables 37 and 38) the X group is superior in 61 per cent of the 120 comparisons in General Science and in 74 per cent of the 120 Geography comparisons.

TABLE 35. SUMMARY OF THE MEAN SCORES OF THE X AND THE C GROUPS ON THE TOPICAL TESTS IN GENERAL SCIENCE BY TOPICS AND CITIES

City	Groups	Topic									
		Hot Air Heating	Atmospheric Pressure	Compressed Air	Water Cycle	Water Supply	Purifying Water	Limestone and Marble	Sand and Clay	Reforestation	Planting and Care of Trees
A	X	17.4	10.0	14.1	13.8	20.5	22.7	15.4	22.4	21.9	19.4
	C	20.9	16.4	17.4	22.5	21.7	17.9	18.6	17.8	21.7	21.8
B	X	17.5	13.3	16.4	16.2	24.9	28.2	25.8	23.8	20.1	23.1
	C	23.1	15.1	15.7	24.6	24.3	18.6	18.1	17.9	21.9	23.3
C	X	17.8	17.2	21.2	18.9	23.7	26.6	21.1	30.4	23.9	21.8
	C	18.9	17.0	13.6	19.2	18.1	16.8	18.1	16.6	20.4	21.5
D	X	13.25	9.9	13.3	12.7	13.4	16.8	13.7	20.1	18.4	19.3
	C	13.3	8.2	7.4	9.6	11.5	8.4	8.5	7.9	11.8	12.25
E	X	20.0	14.4	16.6	15.1	18.3	18.9	14.4	19.5	15.7	20.6
	C	26.6	23.8	19.4	23.1	30.1	22.2	20.9	22.7	26.8	26.7
F	X	22.8	18.4	20.4	22.0	25.7	27.3	31.3	32.8	25.5	30.8
	C	19.1	15.1	15.0	19.2	21.5	17.4	21.6	15.3	23.4	22.5
G	X	23.3	20.7	23.0	26.4	25.0	25.5	25.1	29.25	26.9	28.1
	C	18.7	15.6	9.7	20.4	25.6	18.0	16.9	14.4	21.9	25.2
H	X	14.75	11.75	10.0	15.75	25.25	18.0	21.3	19.0	18.75	21.25
	C	20.5	10.25	14.0	17.5	25.0	17.3	22.7	21.25	24.1	25.1
I	X	7.45	5.65	9.45	8.9	12.7	9.15	10.0	14.6	See Note	See Note
	C	5.6	1.7	6.8	9.3	15.0	8.9	11.1	7.9		
J	X	20.3	17.1	21.1	20.3	23.75	23.7	24.6	27.0	22.8	23.0
	C	21.8	15.4	13.4	16.1	19.8	17.3	20.7	20.1	22.6	23.7
K	X	19.25	24.0	22.0	22.3	22.3	20.7	19.5	23.8	23.2	18.1
	C	20.75	13.3	16.0	17.3	20.3	24.0	18.3	16.0	24.0	22.8
L	X	17.0	21.5	11.75	17.0	19.0	15.5	17.0	19.9	18.25	19.6
	C	12.6	14.75	13.0	14.5	23.25	12.8	12.4	14.1	16.6	17.7

Note: No test papers were turned in from City I on the last two topics.

TABLE 36. SUMMARY OF THE MEAN SCORES OF THE X AND THE C GROUPS ON THE TOPICAL TESTS IN GEOGRAPHY BY TOPICS AND CITIES

City	Group	Topic									
		New England Fisheries — Cod	Wisconsin Dairies	Wheat	From Wheat to Bread	Cattle	Corn	Cotton Growing	Irrigation	Bituminous Coal	Iron Ore to Pig Iron
A	X	25.4	13.6	10.3	11.9	13.1	18.6	21.2	11.0	17.4	15.5
	C	23.5	14.2	10.3	13.4	12.9	17.6	18.0	8.9	13.6	12.0
B	X	30.9	17.0	14.6	18.2	16.4	21.1	25.2	14.4	22.0	23.2
	C	27.2	13.6	14.3	17.0	19.8	18.1	22.5	12.3	19.6	23.3
C	X	28.2	14.8	15.9	18.3	17.9	23.1	23.9	15.9	23.4	25.6
	C	22.3	15.7	14.3	16.1	15.9	20.0	20.9	12.8	19.6	20.1
D	X	20.1	12.4	11.3	13.8	13.0	13.6	18.1	9.3	17.1	18.5
	C	14.7	9.6	7.8	8.0	9.3	13.9	12.1	6.3	11.4	11.2
E	X	29.4	16.4	15.1	17.8	18.7	19.9	25.2	13.7	20.7	23.1
	C	28.4	18.15	17.6	17.75	17.3	21.7	19.8	13.3	18.8	19.4
F	X	28.4	15.3	17.4	17.9	19.9	21.7	26.0	12.15	21.5	22.9
	C	26.9	17.75	17.5	17.7	17.6	20.7	20.2	12.7	20.8	25.0
G	X	27.2	12.2	12.4	15.5	15.8	19.1	20.0	10.5	18.2	18.6
	C	23.3	13.8	11.5	12.7	12.7	18.0	17.7	10.9	12.9	20.6
H	X	22.7	11.9	12.0	12.75	10.9	17.6	15.9	11.5	18.1	17.9
	C	23.3	11.6	6.9	9.6	10.3	10.3	14.9	8.7	13.5	9.2
I	X	28.4	16.0	13.3	14.7	16.3	20.7	23.9	18.3	23.7	25.9
	C	25.8	12.1	9.0	14.7	12.1	14.7	17.5	10.2	18.1	19.1
J	X	23.2	11.9	9.9	13.7	11.9	16.5	17.9	9.3	12.6	19.2
	C	19.65	12.3	10.4	11.9	12.6	13.1	14.8	9.1	13.3	15.7
K	X	27.3	10.0	11.0	14.5	12.8	16.8	16.5	11.4	17.4	16.8
	C	13.0	12.2	9.7	9.2	10.2	12.2	13.3	9.9	14.85	15.3
L	X	22.6	10.9	11.6	11.7	12.0	17.3	18.7	10.5	13.4	18.2
	C	17.2	11.6	7.7	10.0	9.5	13.6	15.8	7.4	12.6	12.2

TABLE 37. INITIAL PER CENT OF CORRECT ANSWERS AND PER CENT OF GAIN IN GENERAL SCIENCE FOR X AND C GROUPS BY TOPICS AND BY CITIES, AND FOR ALL CITIES TOGETHER

The Initial per cents are based on Initial Tests C2 and the per cents of gain on Final Tests C2.

City		Cases	Hot Air Heating		Atmospheric Pressure		Compressed Air		Water Cycle		New York Water Supply		Purifying Water		Limestone and Marble		Sand and Clay		Reforestation		Planting and Care of Trees	
			% Right Init.	% Gain	% Right Init.	% Gain	% Right Init.	% Gain	% Right Init.	% Gain	% Right Init.	% Gain	% Right Init.	% Gain	% Right Init.	% Gain	% Right Init.	% Gain	% Right Init.	% Gain	% Right Init.	% Gain
A	X	143	69.0	16.3	44.6	20.4	39.3	27.1	42.0	21.5	26.9	24.7	46.4	31.7	45.9	22.3	32.3	17.6	38.2	22.2	56.5	—.1
	C	208	72.4	10.4	48.1	25.1	47.0	17.9	48.7	18.7	29.6	28.8	56.8	25.7	51.2	25.0	36.6	16.0	38.2	17.2	58.3	8.3
B	X	72	62.1	17.7	32.5	24.0	35.7	21.3	32.1	16.9	30.6	6.1	39.2	38.4	35.4	31.3	27.0	16.8	33.9	5.6	49.5	16.7
	C	80	65.6	11.6	37.5	24.5	42.0	15.8	35.3	16.1	27.3	20.0	45.6	25.0	40.9	28.6	31.5	9.3	33.1	3.7	49.3	22.9
C	X	235	70.0	14.7	50.0	17.9	50.4	20.6	46.7	18.7	31.9	15.1	54.8	25.6	50.0	27.6	38.2	21.1	39.3	13.6	55.6	11.7
	C	242	66.6	11.6	43.0	15.6	49.5	13.5	42.1	12.5	27.7	11.2	50.1	15.3	46.7	28.9	33.5	14.5	35.9	15.2	51.2	13.6
D	X	220	55.4	12.5	34.2	13.9	38.2	15.0	32.7	11.7	24.9	3.7	36.2	25.7	38.6	23.2	29.1	8.8	32.6	8.7	47.4	10.4
	C	166	57.4	10.5	37.1	16.0	41.5	8.5	39.3	7.2	24.1	6.1	46.9	16.0	43.0	20.8	29.9	10.4	34.1	11.6	49.4	7.8
E	X	127	64.2	13.4	47.9	10.7	44.6	16.2	43.8	12.5	27.4	5.5	49.1	17.7	43.4	22.2	34.9	9.4	38.0	7.2	55.4	5.8
	C	122	82.1	5.6	64.6	8.0	56.2	11.2	48.4	11.9	35.3	14.3	64.8	6.8	52.4	23.5	41.4	12.7	41.8	14.2	57.0	13.6
F	X	157	71.2	9.8	47.0	20.4	43.3	21.9	44.0	20.4	31.4	18.8	50.8	26.4	43.8	33.5	33.8	23.6	36.4	18.6	54.2	12.8
	C	157	73.0	9.3	45.5	12.8	44.2	14.3	45.4	12.8	31.5	11.2	56.7	12.9	50.2	21.0	35.6	7.9	39.4	8.0	54.0	10.8
G	X	36	73.9	10.3	53.3	13.3	49.2	20.2	41.7	19.4	39.4	9.5	53.8	26.8	64.2	18.3	45.5	16.5	31.7	28.0	51.4	10.6
	C	52	72.5	5.6	42.7	9.1	42.3	16.3	49.2	5.4	36.2	14.0	54.2	10.6	48.9	18.4	32.5	10.6	36.9	2.1	49.6	10.6
H	X	35	44.6	30.6	31.1	24.3	33.2	28.2	25.4	26.6	27.4	11.7	34.9	39.7	35.7	35.7	28.0	12.9	30.9	18.0	47.4	15.2
	C	31	55.2	28.7	31.0	41.0	40.7	31.5	37.1	25.5	29.4	24.2	31.3	18.7	29.0	43.0	25.8	29.0	29.0	33.9	38.1	24.5
I	X	134	44.2	11.8	26.3	13.8	29.3	17.3	31.7	9.7	23.6	—1.2	28.1	17.6	38.5	16.1	26.7	4.6	34.4	6.6	40.6	6.5
	C	77	47.4	11.0	31.3	1.3	34.3	14.9	31.0	9.1	27.9	1.2	32.5	12.8	40.0	16.9	25.2	5.1	34.7	4.8	44.3	2.6
J	X	128	69.0	15.6	46.4	18.8	44.8	23.1	45.9	15.3	31.5	12.7	49.4	32.2	46.7	26.5	39.3	14.3	35.5	20.9	51.0	11.0
	C	137	68.1	11.7	46.5	16.0	45.4	19.4	46.2	9.6	29.7	15.8	45.9	26.3	49.2	25.6	38.0	11.0	34.9	18.1	52.4	12.2
K	X	28	78.6	4.6	57.2	11.8	52.8	22.2	48.9	14.7	35.4	9.6	52.8	18.6	53.6	19.2	33.6	18.6	40.7	13.9	59.0	12.0
	C	26	68.1	13.1	60.8	20.7	52.3	10.0	52.3	12.7	39.6	14.2	51.2	27.6	49.2	27.8	40.0	12.7	41.9	11.2	56.2	7.2
L	X	37	66.5	13.0	41.9	17.3	44.9	23.5	43.5	15.7	30.6	17.8	48.4	24.4	37.3	30.3	29.5	12.7	23.9	15.4	52.2	3.5
	C	45	64.4	15.0	41.1	22.5	46.2	16.5	36.2	26.7	25.8	18.4	45.8	25.0	41.3	25.6	29.6	10.0	33.1	15.8	49.1	6.5
All		1417	60.6	13.3	40.3	16.2	40.0	19.4	38.4	15.4	27.6	10.6	43.1	25.1	41.9	24.1	31.7	14.1	34.1	13.1	49.2	8.8
Cities		1278	70.9	11.1	46.9	17.4	48.2	15.6	45.5	13.7	30.9	15.5	53.3	18.9	49.3	26.4	36.0	12.8	38.4	13.7	54.8	11.1

TABLE 38. INITIAL PER CENT OF CORRECT ANSWERS AND PER CENT OF GAIN IN GEOGRAPHY FOR X AND C GROUPS BY TOPICS AND CITIES, AND FOR ALL CITIES TOGETHER

The Initial per cents are based on Initial Tests C2 and the per cents of gain on Final Tests C2.

City	Cases	New England Fisheries Part I — Cod		Wisconsin Dairies		Wheat		From Wheat to Bread		Cattle		Corn		Cotton Growing		Irrigation		Bituminous Coal		Iron Ore to Pig Iron	
		% Right Init.	% Gain	% Right Init.	% Gain	% Right Init.	% Gain	% Right Init.	% Gain	% Right Init.	% Gain	% Right Init.	% Gain	% Right Init.	% Gain	% Right Init.	% Gain	% Right Init.	% Gain	% Right Init.	% Gain
A X	391	42.2	31.2	49.8	28.6	25.7	15.7	23.1	8.3	36.5	28.0	37.5	26.7	57.2	12.6	28.4	22.8	41.4	26.2	34.1	28.9
C	372	43.9	28.1	49.4	24.2	26.1	19.8	21.2	4.5	35.5	25.2	38.0	22.6	54.4	13.2	28.1	14.5	40.8	16.4	33.5	24.4
B X	227	50.8	23.8	53.0	27.4	35.8	13.5	22.7	13.7	39.7	30.0	41.5	26.4	54.6	16.9	29.1	25.5	46.8	18.4	39.0	30.1
C	196	53.6	25.6	54.6	23.0	33.2	14.9	25.1	4.6	41.9	29.5	44.4	24.0	57.5	38.8	31.5	21.1	47.2	15.6	38.6	30.6
C X	273	48.3	28.9	60.1	24.1	33.5	17.7	23.6	12.5	49.8	22.4	43.0	32.0	49.8	19.2	33.0	27.0	41.1	27.1	37.8	41.1
C	297	57.3	15.9	60.5	17.5	32.4	16.0	22.5	7.4	48.4	19.5	46.5	20.7	50.1	17.6	36.9	21.9	39.5	19.5	38.5	26.3
D X	232	43.2	25.4	46.0	24.3	32.5	11.0	22.9	10.0	32.7	28.6	36.0	21.4	46.7	17.9	27.7	17.7	37.6	28.4	39.0	29.0
C	203	49.7	15.3	46.8	15.6	29.1	14.5	21.1	4.0	32.9	28.6	38.1	15.3	43.2	19.0	29.0	11.3	41.4	17.0	36.4	24.0
E X	379	42.0	33.8	48.1	29.1	33.5	12.6	21.8	11.4	42.9	25.5	45.7	22.5	57.3	10.1	36.4	17.1	43.8	25.2	40.3	32.1
C	237	53.1	21.7	54.0	24.6	32.8	16.4	25.3	6.3	51.2	17.4	62.4	20.4	61.3	8.1	38.0	14.4	47.6	17.8	44.8	24.5
F X	254	46.5	28.9	55.2	25.1	37.0	11.2	22.1	11.2	44.2	27.8	49.4	25.7	52.1	18.1	31.0	25.3	45.3	25.3	45.7	29.7
C	192	52.6	23.6	57.4	22.6	34.8	14.7	21.7	7.4	42.9	25.1	49.2	25.9	50.9	21.9	28.0	23.8	44.4	19.2	48.0	28.5
G X	237	58.3	15.4	51.8	21.0	27.6	16.8	21.8	11.4	40.1	23.3	42.6	21.0	66.2	12.5	31.5	15.9	44.2	17.7	40.2	25.3
C	236	53.5	21.2	53.3	23.1	30.3	16.9	21.4	7.6	41.2	25.4	45.1	21.7	63.9	15.1	32.3	15.9	47.1	16.0	43.8	23.0
H X	82	44.4	24.6	42.5	28.9	26.3	14.9	19.8	9.7	26.8	35.4	30.1	26.0	37.3	28.2	22.7	24.4	39.9	21.3	28.7	36.7
C	112	46.9	21.6	47.3	15.5	25.9	10.3	18.2	4.9	28.3	25.2	32.6	17.6	38.9	22.6	23.8	14.6	36.5	18.2	28.2	23.8
I X	103	40.0	31.6	46.6	28.8	26.9	17.0	20.9	12.2	42.7	26.5	36.4	42.2	45.9	20.4	30.5	27.6	38.8	27.4	29.2	42.2
C	101	49.5	25.3	50.8	21.6	27.9	17.4	24.0	3.8	46.6	19.2	43.0	22.1	55.1	15.5	34.7	19.1	43.7	19.0	39.4	24.4
J X	163	39.5	27.7	47.1	21.5	38.2	2.0	21.2	7.2	37.1	28.9	37.1	17.3	40.0	22.8	24.6	16.9	36.9	21.6	31.1	31.0
C	174	41.1	27.2	47.4	20.8	35.4	7.1	17.5	2.7	34.4	29.0	36.7	18.7	67.9	23.3	24.5	19.0	36.4	24.4	33.6	33.2
K X	86	42.9	29.1	43.8	29.8	19.6	20.1	22.7	11.2	39.9	20.5	39.0	17.7	47.2	14.4	29.6	17.5	41.0	22.6	27.9	31.8
C	84	41.6	29.4	41.2	29.6	24.3	15.2	18.0	6.7	38.2	22.4	33.0	22.2	69.1	16.6	27.7	12.7	36.2	22.8	24.5	34.3
L X	611	38.2	30.4	44.0	31.0	25.8	19.1	21.4	8.5	29.7	32.4	35.8	24.4	43.7	16.7	24.8	20.7	37.7	23.5	31.4	27.2
C	468	40.1	29.7	43.5	25.4	26.0	21.7	20.2	4.0	30.1	27.3	35.1	21.2	44.8	19.0	25.4	15.9	40.1	17.1	31.7	24.7
All	1930	44.3	28.3	49.4	27.0	30.4	14.7	22.2	10.1	38.3	27.8	38.6	24.3	50.5	16.1	28.2	22.0	39.5	25.4	36.4	30.9
Cities	2672	48.2	23.9	50.6	22.3	29.7	16.6	17.7	9.1	38.8	24.8	39.1	23.4	49.7	16.9	30.3	17.0	42.3	17.9	36.5	25.9

SUMMARY

1. The Comprehensive and Topical Tests agree in all the total comparisons in indicating substantial and consistent superiority of the X groups over the C groups. They agree also in suggesting that the superiority of the X group may be greater in Geography than in General Science.
2. The two series of tests agree closely in ranking the 12 cities according to degree of superiority of the X over the C groups.
3. The two series of tests agree closely in ranking the ten topics in each course of study according to degree of superiority of X over C groups. The agreement here is remarkable in view of the limitations of both types of tests on single topics.
4. The available data are not adequate for judging the relative educational effectiveness of the individual films used in this experiment.

CHAPTER VIII

ANALYSIS OF QUESTIONNAIRE ANSWERS

Purpose and Nature of Questionnaire: Reliability of answers — Summary of answers — Contributions of Films as Observed by Teachers: Arousal of interest — Maintenance of interest — Quantity and quality of reading — Project work — Effect of advance announcement of films — Classroom discussion and writing — Correlation of materials — Richness, accuracy, and meaningfulness of experience — Teachers' organization of lesson materials — Teaching more pleasant and self-activity greater — Influence of time-schedule on teachers' answers — Reproduction of verbatim answers of all teachers — Summary.

PURPOSE AND NATURE OF QUESTIONNAIRE

As indicated in Chapter I, it was planned from the outset to secure an unbiased statement of the opinions of the X teachers on the effectiveness of the films in attaining the usual objectives of good classroom practice. We believe that the consensus of opinion of a large group of teachers, after eight weeks of experience with eight of a series of ten films, is a valuable, if not indispensable, type of evidence to add to the data derived from the tests and presented in preceding chapters. However, we feel that the reader should be reminded again that here, as elsewhere in this investigation, we are concerned with two particular sets of films, and that the evidence here collected has a general significance only in so far as films in general are similar to those which were used in this experiment. If some "educational" films in the past have failed, it is largely because of the vain effort to adapt the films to areas of instruction which can be better presented through other media, such as still pictures, lectures, and reading; or because the films have not been happily articulated with the total school

situation. Both the primary and secondary contributions of the films will be greatest when the films are reasonably restricted to materials which can be better presented by motion pictures than by any other practicable means. This does not mean that each and every film must be exclusively devoted to motion studies, omitting or leaving to other media every detail which ordinarily can be presented as well verbally or in writing as by visual methods. Such an absolute prohibition, or restriction, would be fatal to the continuity and completeness of any lesson or series of lessons presented by any medium or method of instruction.

The questions in the questionnaire with which we are concerned in this chapter relate to the ordinary objectives of good classroom teaching, and the teachers have largely answered the questions from that viewpoint, alluding to the special or unique contributions of the films only in passing. In preceding chapters we have suggested the problem of what types of information and sequences of ideas are best adapted to the motion picture film as a medium of instruction, and we shall return to that problem in Chapter X. In the present chapter we return to the primary purpose of the whole experiment; namely, to ascertain the magnitude and nature of the contribution which classroom films make to the ordinary objectives of good teaching, such as the arousal and maintenance of interest on the part of students, the stimulation of more extensive reading on the part of students, the correlation of early with recent learning, the accuracy and meaningfulness of the experiences and ideas which children get in school, the effect of the classroom films on the teachers, etc.

Reliability of answers. We naturally feel considerable confidence in the questionnaire returns, because they agree substantially with our own observations. In our visits to the schools in ten of the twelve coöperating cities, it was

perfectly obvious that the X classes in at least eight cases out of ten were far above the C classes in all of the visible criteria of effective school work. The X classes were more active in the classroom, they asked more pointed and larger numbers of questions, they discussed their own and the teacher's questions with greater freedom, and with an obviously greater wealth of detailed information than the C classes. The information which the X children brought into the classroom discussions was generally more appropriate than that which appeared in the discussions of the C classes. It was also strikingly spontaneous — a feature which accounted to a large extent for the liveliness and satisfyingness of activities in the X classrooms.

Some of the information which the X children brought into their discussions was secured directly from the films, but much of it could not have been gained from the films, and was undoubtedly gained from the wide reading stimulated by the films. A very striking difference which we observed, and which has been commented upon by many of the X teachers, is that the X children retained materials and ideas much longer and used them more effectively in discussions than the C children. We observed many times during the last three or four weeks of the experiment, that children in the X classes would bring into the discussion materials from the first two or three films.

We also feel considerable confidence in the questionnaire returns because the questionnaires were sent out and were answered after the teachers had used seven or eight of the ten films, because the teachers understood their answers would be treated in a strictly confidential way, because the answers are not all favorable, because there is fairly good agreement between the answers of teachers in different cities, and finally because many of the answers are supported by citations of concrete evidence. The question-

naires were sent out in mimeographed form with the following caption:

EASTMAN CLASSROOM FILM EXPERIMENT

Special Report of Teachers of Experimental Groups

______________________; City________; School________
(Signature of Experimental Teacher)

This report is desired by the experts in charge of the tests conducted in this experiment. The information requested is for their confidential use. The courtesy of the experimental teachers will be appreciated if they will send this report IMMEDIATELY to Dr. Ben D. Wood, in the enclosed addressed, stamped envelope. Please discuss freely the points raised and give incidents in support of your answers to the following questions.

Summary of answers. Replies were received from eighty-seven (or 93.5 per cent) of the 93 teachers who taught X classes. Seventeen (or 65 per cent) of the general science and seventy (or 100 per cent) of the geography teachers responded to our request. The returns from general science and geography teachers will be presented together, since there were only one or two differences observed, and these will be mentioned in the text of the following pages. Table 39 shows the numbers and per cents of teachers giving favorable, qualified, and adverse answers to each of the ten questions in the questionnaire. It is clear from this table that the judgment of the X teachers is overwhelmingly favorable to the films.

CONTRIBUTIONS OF FILMS AS OBSERVED BY X TEACHER

1. Arousal of interest. Eighty per cent of the teachers believe without qualification that the films are highly effective in arousing interest. The favorable answers given on page 150 are among the most interesting of those given:

TABLE 39. SHOWING NUMBERS AND PER CENTS OF X TEACHERS ANSWERING EACH QUESTION ON THE QUESTIONNAIRE IN VARIOUS WAYS

The number of teachers who answered the questionnaire is 87, and the per cents are figured on 87 as a base. There were 93 teachers in the X group.

Question Number	Favorable		Favorable but Qualified		Adverse		No Answer	
	No.	%	No.	%	No.	%	No.	%
1. Are you able to arouse more interest on the part of the children with the use of the film than you have usually obtained in your classroom work without the film?	70	80.5	9	10.3	3	3.5	5	5.7
2. Are you able to develop a more sustained interest by the use of the film? In other words, do your pupils bring in more material on a topic taught by the film after the study of such topic has been completed than has been usual in your teaching experience?	60	69.0	14	16.0	8	9.3	5	5.7
3. How has the film affected the quantity and the quality of the children's reading?	65	74.3	13	15.0	4	4.6	5	5.7
4. Has the film stimulated project work or other self-activity of the children?	55	63.0	19	22.0	7	8.1	6	6.9
5. Did the advance announcement that a film would be shown stimulate pupils to read about the film topic before the film was shown?	37	63.0	9	15.0	13	22.0		
6. Does the film stimulate a greater desire on the part of the children to write on some of the topics covered by the film or to discuss these topics?	74	85.0	5	5.7	2	2.4	6	6.9
7. Does the use of the film cause the children to correlate features of the film with local conditions or personal experience?	79	90.8	2	2.3	1	1.2	5	5.7
8. Does the use of the film increase the richness, accuracy, and meaningfulness of experience and imagery?	77	88.0	4	5.0	0	6	7	
9. Does the use of the film and the guide enable you to organize more comprehensively and easily the material for recitations?	62	71.0	15	17.6	5	5.7	5	5.7
10. Do you get more pleasure out of teaching and are you able to stimulate greater self-activity and originality in the children with the use of the film than without it?	67	77.0	7	8.0	7	8.0	6	7.0

2.[1] The classes as a whole have manifested more interest since the experiment started than any time before. My failures were reduced for the third quarter from 18 per cent to six per cent. The Motion Pictures did this.

4. Decidedly more. They search for information, and bring in reports on topics that have not been assigned, but which bear directly upon the subject.

5. The children are highly interested in the pictures. In fact, they are so interested they all wish to discuss the pictures at one time. They, also, show their interest by scores of questions. Every day they ask if they are going to see a picture that day, and are deeply disappointed if they do not.

11. Absolutely yes. The dullest and most difficult subjects can be made interesting with the use of films.

22. Yes, infinitely more so. This is obvious by the fact that so many more children are willing to talk and take part. There is an eagerness to participate.

29. Most decidedly so and especially with the slow sections.

31. Yes, April 9 being Easter Monday about fifty pupils were absent. I made an announcement — "Thursday night after school I will show the entire film to those who were absent Monday." These pupils had seen units one and two. Thursday night, all but one, who sold papers, were present. Other pupils wanted to come, to decide on some points we had been discussing in class, but as it was an experiment they did not come.

62. From the testimonials of parents who tell me of the interesting discussions their children carry on outside of school, I should say "yes," to this. From the questions and discussions in the classroom I see a decided increase in their interests.

Ten per cent of the teachers qualified their answers. In reality, these qualified answers are just as favorable as the unqualified answers, since the qualifications usually take the form of complaining that the time schedule did not allow for a complete exploitation of the ardent interests aroused in the children by the films. The following answers show typical reservations:

[1] These numbers represent X teachers. In this chapter a given number always refers to the same teacher.

7. Yes, but this interest has suffered because of the short period which prevented self expression.
15. Yes, I think I get more interest with the film than I have usually had with Social Science, although with a *selected* class in Social Science I have had more enthusiasm than I have secured with the film.
16. The first showing of the picture always arouses the interest of the children. They always seem eager for the next one. The interest shown afterwards is about the same as that shown in a well conducted recitation. It was very difficult to hold them down to the picture itself. That is, they wanted to discuss things related to ideas brought out in the film, but due to our limited time on each topic, such discussions were impossible. I do think that pictures can help to stimulate interest.

Less than four per cent of the teachers answered adversely on this point. Even these "adverse" answers are capable of a highly favorable construction, e.g., the following:

32. No. However, the use of the film has been of great interest to the children. The use of the film has not permitted as much pupil activity. I think I had greater interest (individual) before, through *my* way of teaching.

41.[1] No, because we have used films as supplementary work.

[1] In this answer teacher No. 41 is evidently not opposed to films in the classroom, for he makes it clear elsewhere that the motion picture is and for a long time has been a regular and highly regarded teaching device in his school. We have classified most of his answers to the questionnaire as adverse in an effort to be thoroughly impartial in analyzing the returns. Teacher 41, far from being doubtful of the values of classroom films, is one of the successful pioneers in introducing them as a regular part of the teaching program. What he objects to is the way in which our experimental program prescribed that they be used. While we believe that some of his objections are based on a misunderstanding of our directions to teachers (Chapter II), and that this misunderstanding was the main reason why the Control group in his city outdistanced his Experimental students on the tests, we are very sympathetic with some of his strictures on the organization of the experiment. We have already indicated (Chapter I) that we justify some of the arrangements only on the ground of experimental expediency. The rigorous conditions prescribed for the experiment were not intended to serve as a *detailed* model for the regular use of films in the classroom.

82. If the film is clear enough it is invaluable in arousing interest. (Could have aroused more interest without the Irrigation film and guide than with it.)

2. **Maintenance of interest.** Sixty-nine per cent of the teachers unqualifiedly affirm that the interest of the children is more sustained with the films than without them. The following are typical answers:

3. Yes, material on all subjects studied is still being brought by pupils.
4. Yes. For weeks after the topic is finished a picture or a clipping is brought in and discussed without stimulation on the part of the teacher.
5. Yes, they are still bringing pictures on New England Fisheries and other topics already taught. They, also, add to their notebooks whenever they come across material on subjects they have studied.
6. Interest was sustained because it carried over in other subjects. The stories in the Readers and other textbooks that touched upon the topic were read more eagerly. A number of the children would find on their maps places and trade routes of Cod Fishing and the other topics many weeks after the topic was completed. Pictures and interesting compositions were collected. A topic shown would recall activities of a topic shown many weeks previous. The cultivation of cotton recalled the cultivation of wheat and corn, and the mining of iron ore recalled the mining of coal.
8. Yes. Current events are often noticed and mentioned as relating to a film weeks old.
25. I am, and they do. The children's interests have been led far afield from the original starting ground — and "disconnected" ideas joined.
56. Yes, especially with the child of low mentality who has difficulty in visualizing the printed word.
57. Never in my teaching experience has interest in Geography been more intense or sustained. Never have such a large majority been at white heat to do his or her bit in contributing facts or material.
78. The interest continues long after the time allowed to the subject has expired. This is most unusual.

Sixteen per cent qualify their judgments that the films produce more sustained interest, but again these qualifications usually take the form of complaining that the time schedule imposed in this experiment did not permit adequate exploitation of the interest aroused by the films:

15. Some material has been brought in after a film is finished, but usually the child's interest changes with the changing films.
16. It is rather difficult to answer the question on sustained interest. If we had more time for open discussions, I believe the "sustained interest" idea would develop more. I have promised to discuss some of the things with my pupils after the experiment is over. One boy is going to bring in different samples of clay and fire brick and give a talk to his class later on.
20. Much material was brought in while studying a topic, but when the next project was introduced the children's interests were concentrated on the new subject and they stopped bringing materials.
50. With some it worked this way, but with others it was hurry on for something new.
79. Yes, but the time limit of one week per subject is too short and the interest in one subject is partly lost by the introduction of another subject.

Less than ten per cent answered the second question adversely. How "adverse" these replies are may be judged from the following three:

32. No. That is not to the discredit of the film. The film and the method of study with the pamphlets did not give opportunity. Sustained interest was held all the time due to the interesting things brought out in the film.
41. No. Because I use the project method and have all supplementary work planned.
73. No. It has never been difficult in this school to have children bring in material.

3. **Quantity and quality of reading.** Three fourths of the teachers believe that the films increase the quantity and quality of the children's reading. This opinion is confirmed

by the reports of the school librarians. In several cities administrative officers of the schools said that school librarians had reported that library facilities were not adequate to care for the increased library demands of the children involved in this experiment. The librarians that we personally interviewed declared that the increase in the use of the library was due nearly as much to C as to X classes — a fact which should be recalled in connection with what was said in an earlier chapter on the pressure exerted on C students by their teachers to surpass the X classes. Taking the first six answers at random gives a fair idea of the tenor of the teachers' answers to this question.

1. They are learning to use reference books, how to select the main points bearing on the topic for discussion. It causes them to visit the library more often and increases their reading.
2. The experiment has enabled the student to do more reading and to organize the material in a logical way. They do not seem to mind looking up material to aid in the development of the topic assigned.
3. The film has increased the amount of reading. Pupils actually spend hours at the library when books are not available at home.
4. They consult reference books available and find other helpful material without any suggestion being made.
5. The children will now read articles they find on Irrigation, Coal and other topics which they would never have attempted to read before seeing the films. They notice newspaper and magazine articles which base on these subjects more than they would have without these pictures. They would probably read more, if their supply of reading material was not limited.
6. The quality of reading has been improved because the child has an intense desire to find out a definite thing. The study guide was an aid in organizing and judging the information found on the topic. The many contacts the picture gave increased the quantity of reading.

Fifteen per cent of the X teachers qualify their statements that the films improve the quantity and quality of reading done by their students. In general, the qualifications are reiterations of the complaint about lack of time:

23. In our regular work we have made use of rather extensive reading in Social Science subjects. Naturally the children are accustomed to read widely. I cannot say that the quantity and quality has been materially affected by the use of the films. When we did projects, the interest was created through class and pupil initiation. The films have created interest but the time has been too limited for class initiation and self-activity.
24. I believe the quality is better, quantity about as usual. Just what is required.
27. The reports have made them do a good deal of reading but they have not done much that they did not have to, I believe.
42. Children have read much more by themselves, have necessarily read more difficult books, although I believe they didn't always understand just everything they read.
50. Children had reference books at home but hadn't used them much before. If this hadn't been so hurried they would have read more. They brought the books but didn't always get the contents.
52. There is no doubt that the children did much more reading, but unfortunately, the books used were far beyond their comprehension.
76. Yes, in a negative way, there has been little opportunity in the time allotted.

Less than five per cent of the teachers, that is, four out of eighty-seven, answer the question on reading adversely:

28. My class have read widely from many sources, but I cannot say that the quality of the reading has greatly improved.
32. There has been less reading. What reading was done was possibly more directed or focused to the problem.
41. Less in each case. Because the film has been the "Headliner" and all was expected from film as an easy method to obtain information.
65. They read less. Because they don't read textbooks now.

The reader will have noticed that the most adverse answers to all these questions are contributed by the teachers whose identities we have concealed under the numbers 32 and 41. We have already noted in Chapters IV and VII, and elsewhere in this chapter, that teacher 41 did not approve the plan of this experiment, and participated practically under duress.[1]

4. **Project work.** Sixty-three per cent of the teachers say that the films stimulated their students to an extraordinary degree in undertaking projects and other types of self-activity. Twenty-two per cent of the teachers gave answers which we have classed as qualified. Nearly all of these qualifications are reiterations of the complaint that the films so enriched the curriculum that the time was too brief for adequate exploitation of the interest aroused by the films. The first seven answers illustrate the tone of the eighty-five per cent of teachers who gave unqualified and qualified favorable answers.

1. Yes, booklets made, both classes and individual charts. Planned trip to Bakery — visit, letters of thanks sent to Bakery on return bringing in Language. Trip to John Deere Plough Co. to study more about farming implements.
2. We have had quantities of material for our experimental work, some of the data and exhibits coming from Italy, England and all over the U.S.A. The children have written to some forty companies for material to aid us.
3. Yes. Children have made trips to dairies, cotton mills, Plow Co., etc. They have made boats, schooners, and carved cows from soap.
4. Yes. Charts and booklets are made, and collections of interest gathered.
5. Yes, the children have made booklets on the different topics, and of their own accord made illustrated note-books. The pictures could be of great aid in project work if it were not

[1] See footnote, page 151.

for the limited time. For instance, a child was so interested in this topic of Irrigation that she wanted to make a sand table showing the methods of Irrigation, but for lack of time to discuss, lost interest in it.

6. The film has stimulated project work. The children collected in many different ways data and illustrations on the topics studied. They have written to many places of great distance asking for literature and samples. They have spent much time away from school arranging these samples on charts or making booklets.
7. It would have, had we been able to utilize the interest. We were asked not to carry over the picture in such a way as to add to time giving information. The children have worked up several projects independently.

Seven of the eighty-seven teachers say that the films did not stimulate project work. The text of these adverse answers shows that while the teachers making them are undoubtedly reporting the facts for their classes correctly, the answers are far from being unfavorable to the films.

32. No. It could, however, if handled according to *our* way of teaching.
41. No, because project work and self-activity are our hobbies and is a "daring" program while films should be supplementary information.
65. No. (Note. Most of our children are very poor and of foreign parentage (Portuguese) and have little material at home. Our school is new and we have as yet a very meagre library and a little supplementary material collected.)

5. Effect of advance announcement of films. Fifteen teachers did not make advance announcement of films to be shown. This was probably due to misunderstanding or lack of time, or both. Sixty-three per cent of the fifty-nine teachers who did announce the next film to be shown, give highly favorable answers to question number 5. The following are typical answers:

1. Yes. I have had children say, "Miss Brown, I am going to the library this P.M. to return a book. What is our next picture? I want to know what else to get." Some are still reading on some past topics.
5. Not at first, but toward the last the children asked me before the picture they were then seeing was finished, what the next one would be and some brought pictures and read about it.
11. They sent ahead to the U.S. Government to get bulletins.
22. The children have always asked ahead what the next subject would be. Until the last two films I did not tell them. When I did tell, they brought material on the topic, and told me of some things they read.
36. Yes. I usually assigned the reports beforehand and many brought in material even before the film was shown. Some would ask what the next topic was going to be before we finished one. Some wanted to know so they could get library books.

Fifteen per cent of the teachers give qualified answers, and twenty-two per cent adverse answers. Ten of the thirteen teachers giving adverse answers were general science teachers. Lack of time and lack of appropriate library facilities seem to account for these adverse answers. The following are typical answers in the qualified and adverse groups:

25. Not in any noticeable degree. "Too busy."
28. No. The children had little or no time to read about a topic before the showing of the film.
32. I am not inclined to believe that it did.
41. No, as films are not new with us, but have used them before at regular intervals — 2 each five-week term.[1]
50. No, they were busy finishing up the old and didn't have much time — they always wanted to know what was coming next, however.

6. Classroom discussion and writing on film topics. Questions 6 and 7 are especially significant for the purpose of this experiment. The teachers are almost unanimous in

[1] See footnote, page 151.

saying that the films stimulate greater discussion and more extensive writing by the children than they have ever been able to secure without the films. This practical unanimity strikingly confirms our own observations in visiting the classrooms in ten of the twelve coöperating cities. We have never seen in many years' teaching experience and in observing classroom practices, more liveliness or a more sustained discussion than we observed in the X classes.

Eighty-five per cent of the teachers gave unqualified favorable answers to question 6. The contribution of the visual experiences to the ordinary discussion is emphasized by many teachers. For example, one says that the children "enjoy writing and talking about the things they have seen." Another teacher says that "the children have discussed the films a great deal with each other at home." Other teachers emphasize the value of the films in carrying the school experiences into the homes and in providing material for composition work. For example, one teacher writes:

> 20. The films have been extremely helpful and decidedly advantageous in providing material for composition work. The children are very much interested in writing letters to pupils who have been absent from school and explaining the films to them. The letters and compositions contain much worthwhile information. The children are keenly interested in discussing the films at home.

Another teacher reports that the films stimulate "a real desire to talk and write on some of the topics; this manifests itself in the English class especially."

No one who has observed the use of films in classes would ever fear that the children would lose along the lines of vocabulary and self-expression, but in view of the fear expressed by some conservatives, it is reassuring to find many teachers reporting specifically that the films have increased

the vocabularies of the children, both in high and low sections. For example, one teacher reports that:

33. The children in this group write poorly as they are a retarded group, mostly of foreign parentage, but they are enlarging their vocabulary more rapidly and they enjoy discussing the topics both formally and during their free periods.

Another teacher says that the films seem "to stimulate children more in being able to make diagrams and in discussions." One teacher refers enthusiastically to the fact that "so many points are clarified" by the films that the children could not understand before, and another is equally enthusiastic because the children, after the use of the films, "are able to describe things more vividly and accurately." The three following reports seem especially significant:

79. Yes, decidedly. The class newspaper was greatly improved.
80. Yes, and it also increased their ability to do so. They were interested in finding words to express their thoughts.
82. Yes, we could take much more time discussing some current phase of a subject already past, if we had time. Newspapers mean more to the class.

Five of the eighty-seven teachers gave qualified answers and two gave answers which we have classed as adverse. Nearly all of the qualifications refer to lack of time. Several teachers, however, qualified their answers by saying that the students' discussion is increased, but not their writing. One teacher makes the qualification that the discussion and writing of a very dull class was not observably increased by the films. The two adverse answers are given by teachers number 41 and 75. Teacher number 41 has already been referred to in preceding paragraphs. The answer he gives for question 6 is "No, for reasons above given." Teacher number 73 says, "I think not to any great extent."

7. Correlation of materials. The better correlation and interpretation of materials reported by the film teachers

seem to be due in large part to the fact that the films provoke not only greater immediate self-activity, but promote longer and more vivid retention. In this connection the unpublished preliminary report of Professor Woodworth, on the results of some tests given to audiences immediately after and one week after seeing a film in a theater, is of considerable interest. The fifth paragraph on page 5 of that report offers striking confirmation of the reports of the X teachers:

As to the understanding and retaining of a picture, we have some rather suggestive facts. A five-reel "Western" film was shown, as a free entertainment, and afterwards, without previous warning, blanks were handed out containing questions to be answered on the subject of the film. In other villages, with population of the same (tested) intelligence, the question blank was not produced until one week after the pictures had been seen. The absolute scores obtained are of no great significance, depending as they do on the particular picture and the particular questions asked; but what is highly significant is that the score after a week's intermission was 80 to 85 per cent as high as it was directly after the picture had been seen. In other words, there was but a very slow loss of what had been seen and understood. Compare the figure just given, 80 to 85 per cent, with a corresponding figure obtained for recall, after one week, of the content of a college lecture, where the students knew in advance that they were to have a special test on this particular lecture, and were consequently stimulated to extra effort. In such a test, the score is only 57 per cent as high after a week as it is directly after the lecture. In other words, the "curve of forgetting" proceeds much more slowly after a motion picture than after a lecture. This would not be possible except for an extremely alert attitude on the part of the audience during the exhibition. Though the audience is looking for entertainment, we cannot think of them as mentally passive during the show; they are probably more alive, intellectually, than during a lecture.[1]

More than 90 per cent of the teachers gave enthusiasti-

[1] From a mimeographed memorandum signed "R. S. Woodworth," and entitled, "Preliminary Report of Psychological Research on Motion Pictures, Conducted in Columbia University in 1926."

cally favorable answers to question number 7. Such answers as the following are typical:

8. Very much more than I have ever secured in any other way.
15. Yes; in the wheat, dairy, irrigation, and other films that the children were familiar with, there was a marked tendency to make use of personal and family experiences. Many children of their own initiative visited a local bakery, some a dairy.
18. Many times correlation was made between the features taught by the films and the reading lessons. Time and again children referred to the films to answer a real problem.
20. The subjects treated in the films have stimulated the children to recall their own experiences, make comparison with local conditions, and have instilled a desire to learn more about these things.
22. Yes, in the case of every film this has been true. Some boys told how they had milked, helped with farm machinery, etc. They told how they had seen rodeos, about the neighborhood bakeries, etc.

In our visits to the X classrooms, teachers often remarked on the fact that the children were constantly correlating features in different films. The answer given by teacher 31 is interesting from this viewpoint:

31. It does. After seeing in the film where red hot coke is pushed out at Mr. Ford's coke plant. Three boys' fathers had worked in a Pennsylvania coal mine. The pupils often correlated one part of a film with another in a new film. Example — Coal is taken to the top of the mine tipple, like the wheat taken to the top of the mill.

Our confidence in the questionnaire returns is naturally increased when teachers support their opinions with specific examples:

45. Yes. This was evident time after time. When "Irrigation" was the topic several children brought in the illustrated article on "What's the Matter with Nebraska." This article told of the floods and water waste which could be avoided by dams and irrigation.

50. Yes, in general. They were curious to prove and see for themselves — they made several visits around town and country.

Other typical answers given are as follows:

57. This is one of the happiest features of the work. Children have to correlate their personal experiences on farm, in use of products at home, or in securing them from dealers.
63. Yes. Many personal stories were told while discussing films.
72. Yes. The film seemed to be the "self-starter" which many of the children needed.
75. Yes. This, I feel, is one of the things in which the film excels. Children who have little to say as a rule wanted to relate their experiences, inspired by the film.
80. Many of the children interested their parents to such an extent that the parents went with them to visit local plants.

In the face of such reports as we have quoted above, the one adverse answer given to this question may be called the exception that proves the rule. Teacher number 73 who reported adversely on question number 6, gives a similar report for question number 7. His answer is, "Not to any great extent."

8. Richness, accuracy and meaningfulness of experience. The answers to question number 8 are as unanimously favorable as those to question number 7. The only difference seems to be that the teachers wax more enthusiastic in answering question number 8. The preponderance of opinion is so great that discussion seems unnecessary. Only 5 per cent of the teachers qualified their answers in any way, and not one gave an answer which we could classify as adverse. The qualified answers, with a single exception, assert that the films do contribute to the richness and accuracy of experience, but that some parts of the films could be improved. Of course this is a perfectly legitimate reservation with which the writers and the makers of the Eastman Teaching Films heartily sympathize.

The one unfavorable exception is, again, the answer of teacher number 41:

41. Can't see that it does more than make things visual.

Typical answers given by 98 per cent of the teachers are as follows:

5. Yes, one day I saw a little girl working industriously at something apart from what the class was doing and discovered that she was drawing pictures of parts of pictures she had seen. Every day children bring to me pictures they have drawn of boats, shaft mines, blast furnaces, and maps of sections they have studied.
7. Yes, I believe if the film could take its natural place in teaching any topic as an aid in presenting instead of the limited use we have been able to make of it, it would be invaluable.
11. Indeed it does. They have learned many new words.
15. Yes, I feel sure that the child gets clearer information in many ways than he would get from reading. Many things that are difficult to understand on the printed page are made clear in the film.
19. Yes. The discussions, also the drawing, show me that they are observing pictures in books more accurately in their relation to the film, also that they read more accurately in relation to the film.
33. Yes, children get a much more concise conception of processes through the picture than through the printed word which conveys little to this group.
34. Mental picture is more lasting and richer than one that a child would obtain from a printed page. Representation is accurate.
36. Yes. The pupils seem to be able to express themselves better, both orally and in writing.
37. Yes. It has made industries *real* to children.
80. Yes, not only of pupil's but the teacher's.

The answer of teacher number 80, just quoted above, is typical of the remarks made to us by many of the teachers in our visits to the classrooms and in letters which they have written to us.

9. Teachers' organization of lesson materials. One of the purposes of this experiment was to discover ways of improving the films, and of improving the method for using them as a regular and integral part of the daily classroom program. Thus, one weakness in the program that appeared very early in the experiment was that the time schedule was both too strict and too inflexible to secure the full benefit of the films. We have already explained that the inflexibility was required by the desideratum of uniformity in the experiment, and that the brevity of time allowance was imposed by factors beyond our control. It was in an effort to alleviate the time stricture that the consent of the schools was obtained to allow one or two additional class periods for some of the topics, as described in Chapter I. We also secured many hints as to ways of improving the films. These will be discussed, it is hoped, in a later report.

The purpose of question 9 was to ascertain the opinion of the teachers on the effectiveness of the method of using the films which was prescribed in the Experimental Teachers' Guides, as well as their opinion on the inherent value of the films in facilitating effective organization of classroom exercises. While expressing general satisfaction with the guides, the teachers have contributed several valuable suggestions for their improvement.

Seventy-one per cent of the teachers are convinced both that the films promote and maintain effective organization for classroom exercises and that the Study and Teachers' Guides are soundly constructed and very helpful.

Seventeen per cent of the teachers gave answers which are favorable, but qualified, and about six per cent gave answers which we classified as adverse. This question would have given clearer results if it had been divided, because nearly all of the qualifications referred to the guides and not to the contribution of the films in promoting and maintaining an

effective organization of teaching materials. Analyzing the answers of the teachers for these two points separately, we find that about ninety per cent of the teachers are convinced of the organizational value of the films, that eighty per cent find the guides very effective, and that twenty per cent qualify their answers on the guides by making reservations as to (*a*) the time allowances laid down by the guides, (*b*) the difficulty of the language employed in the guides, and (*c*) the excessive amount of details included in the guides. Many teachers revert to the complaint that the time allowances were too short. Seven of the seventeen who qualified their answers on the guides think them too difficult, and several think them too detailed. One teacher made the qualification that "I have not had enough experience with the films to get the most use of them or to judge the results accurately." Another teacher declares that:

32. The use of the film without the guide would be more satisfactory for me. More explanatory and descriptive material would be valuable if brought down to the level of the pupils of this age.

The three most adverse answers are as follows:

41. No.
42. No. I find that children do not find interest in discussing film as outlined in their "Study Guides" and in the "Teachers' Guide." It seems to me to be better to let them organize own material instead of giving them the organization and letting them discuss it. They would be more interested if they did it all themselves.
44. Not during this hurried experiment, but see great possibilities in using them in my regular work.

10. Teaching more pleasant and self-activity greater. Both in oral remarks to us and in their answers to question number 10, the teachers were enthusiastic in the opinion that teaching with the films was more pleasant and that the

self-activity of both the students and teachers was greater with the films than without them. Seventy-seven per cent of the eighty-seven teachers answer question number 10 with enthusiastic emphasis in the affirmative. Typical answers are as follows:

1. Yes, it is hard to tell which has enjoyed the teaching with the film most, teacher or pupils.
3. Yes. The class which I now teach is a very slow group. Before the experiment it was very difficult to stimulate any self-activity.
7. The use of the film would be a great advantage. We have hardly given it a fair test in this experiment as time limit to the series of lessons and the daily lesson has only served to arouse children. We have not been able to make use of their desire for activity.
12. Yes. We are sorry to learn that this is the last film. (This teacher answered the questionnaire during the last week of the experiment.)
19. Yes, the class and teacher look forward to that period with great pleasure. I surely hope (and the children heartily agree) that we shall continue to study social science with the vitalizing aid of the film.
20. The abundance of rich material given in the films along with the supplementary reading provide the stimulating thought material for children. I feel that I am going to miss the use of the films when this experiment closes. I appreciate the opportunity of having worked with them and feel that my own teaching experience has been broadened.

Eight per cent of the teachers gave qualified answers, and eight per cent gave answers which we have classed as adverse. All of the qualifications refer to lack of time and even the most adverse of the adverse answers can hardly be interpreted in a way that is unfavorable to the films. The quotation of the four most adverse answers supports this assertion:

32. Yes and no. I enjoy teaching with the film. The pupils do also. The film should only supplement and make richer the

material which is taught. The way which was used in the experiment has used the film too often for the time allotted to the unit of topic. I am for the film in teaching science. I am not in favor of using the literature and procedure as outlined in the pamphlet. It is not adapted to 7th Grade ability.

41. Not as the film is used in this experiment. The film has been used as the *basis* of work and in my estimation should be supplementary to the Problem at hand. In our work, I have divided my work into eight projects as we have eight five-week terms. Each term a project is launched. The project is reached from every angle, and is turned into a "daring" problem and credit is given for the application, and becoming a part of the pupil's daily tasks or routine of work. Pictures are shown only as a supplementary angle. In this experiment too much has been made of the one *smaller project* and the film. The pupils grow tired and the exams are too many. Since they know this is being done for outside people lessens the interest. I think your films fine if used as supplementary work only, and could have possibly 25 during the school year.
71. Cannot say there was any pleasure in films and work required so far in advance of what children could do that most of work had to be done by teacher. I feel that we have been teaching films and not using films as an aid in teaching.
82. I'm sure I would benefit greatly by use of film under normal conditions. During the experiment I've had to rush too madly and limit my lessons too much, covering points that might have been left out and leaving out some which were more important.

These adverse answers are given mostly by the same two or three teachers. These teachers were apparently considerably inconvenienced by the experiment, since for them it constituted an interruption of their regular program to which they found it difficult or impossible to reconcile themselves. In one case it seems that the teacher tried to maintain his own teaching program while using the films and guides. This, of course, is not to be taken as a criticism of these teachers. On the contrary we are amazed at the fact that so many teachers found it possible to coöperate so

genuinely and sympathetically in an experiment which necessarily constituted an interruption of the program in so many schools in the country.

Influence of time-schedule on teachers' answers. A careful reading of the verbatim answers of the eighty-seven X teachers convinces us that if we had at the outset eliminated qualifications and adverse answers based upon lack of time it would be fair to say that ninety-seven per cent of the teachers that answered each question gave highly favorable answers. In confirmation of this suggestion we present without comment Table 40.

TABLE 40. SHOWING THE NUMBERS AND PER CENTS OF TEACHERS WHO REPORTED THAT LACK OF TIME PREVENTED ADEQUATE EXPLOITATION OF THE INTEREST AROUSED BY THE FILM IN THE MINDS OF THE STUDENTS

Forty of the 87 teachers reported that at some phase or other in the experiment lack of time was a factor in the results.

Question Number	Reporting Lack of Time	
	Number	Per cent
1.	3	3.5
2.	6	6.9
3.	7	8.0
4.	19	22.0
5.	8	9.2
6.	6	6.9
7.	9	10.3
8.	9	10.3
9.	12	13.8
10.	16	18.5

Reproduction of verbatim answers of teachers. The preceding discussion and quotations from the teachers' answers to the questionnaire have been presented for the convenience of the reader. We believe that many readers would prefer to see the verbatim answers of the teachers to the questionnaires. Accordingly, we present in the Appendix (pages 332–86), all of the answers of all of the teachers to the questionnaire. The reader will understand, of course, that on the questionnaire the answers of the teachers appeared in immediate juxtaposition to the questions and that therefore some of the answers are not complete sentences. For the sake of giving the reader a first-hand contact with teachers' answers we are giving the answers verbatim without any editing.

SUMMARY

1. The results of a questionnaire answered by eighty-seven (93 per cent) of the ninety-three X teachers are considered reliable and significant (*a*) because the teachers who answered had had seven or eight weeks of experience with the Eastman Teaching Films; (*b*) because the teachers understood that their answers would be treated in a strictly confidential way; (*c*) because the answers were not all favorable; (*d*) because there was fairly good agreement between the answers of teachers in different cities; and finally (*e*) because many of the answers were supported by citations of concrete evidence.
2. A tabulation of the X teachers' answers to each of the ten questions of the questionnaire shows that the teachers are overwhelmingly convinced that the Eastman Teaching Films were highly effective in arousing and maintaining interest; in increasing the quantity and quality of the reading, project work, classroom

discussion and writing; in promoting a more thorough correlation of the materials on the part of students; in increasing the richness, accuracy and meaningfulness of their experiences; in facilitating the work of the teachers in organizing the lesson materials and in making teaching more pleasant and the self-activity of the teachers greater.

3. Several of the answers have been classified as adverse, but analysis of the answers shows that in no case are they unfavorable to the use of motion picture films in the schools. The adverse answers are almost without exception objections to the particular organization of the film instruction prescribed by the writers for the particular purposes of this experiment.
4. A considerable number of answers have been classified as favorable, but qualified, because while approving classroom films heartily they include complaints that the time allowance for the use of the films was not adequate for exploiting fully the ardent interest aroused in the pupils by the films.
5. The verbatim answers of all teachers to the questionnaire are reproduced in Appendix VI.

CHAPTER IX

TEACHERS' REPORTS AND EXHIBITS OF PROJECT WORK

Teachers' Reports: Purpose of teachers' reports — Form of teachers' reports — General indications of reports — Sample reports — Exhibits of Project Work: Character of exhibits — Quantity of exhibits — Indications of exhibits — Photographs of exhibits — Summary.

TEACHERS' REPORTS

Purpose of teachers' reports. All teachers of both X and C classes were asked to make a report on the work done at the end of the instruction in each of the ten topics. The purpose of these reports was twofold. In the first place, it was thought that the writing of a report each week would exert a wholesome influence on the teachers in both groups by stimulating a sustained efficiency of teaching throughout the experiment. It was also hoped that the directive nature of the report blank would tend to equalize teaching conditions in the X and C groups. The reader may see, from the reproduction of the report form below, that it was a weekly reminder to the teacher of the need for stimulating and maintaining pupil-activity in and out of the classroom; that it emphasized for both the X and C groups of teachers the importance of reading assignments, of supplementary readings, of pictorial and other aids, of illustrative materials, clippings, pictures, exhibits, and of collections made by the pupils.

In the second place, it was expected that these reports would record any deviations from the normal procedure of the experiment, and any marked irregularities that might occur. It was also hoped that the reports would furnish a fair basis for estimating the general level of teaching

ability and practice in the X and in the C groups, and for explaining atypical or inconsistent results in given localities.

The reports served all these purposes very well. They afford us a fairly intimate basis for estimating the comparative teaching ability, zeal, and classroom methods of the X and C instructors, and give us convincing explanations of several apparent inconsistencies in the results from the Comprehensive and Topical Test series. In general, the reports are made out carefully and conscientiously. Nearly 99 per cent of the expected reports arrived in time to be used in this study.

Form of teachers' reports. The report form for each topic was mimeographed on a single page of letter size paper, the questions being distributed on both sides of the page to facilitate writing the answers and to facilitate our tabulations of the answers.

The questions on the X teachers' report forms were slightly different from those on the C report forms; but within these groups the same questions were used for all ten topics in both science and geography courses. Hence we reproduce only one X and one C report form (pp. 174–75).

General indications of reports. The reports were studied carefully, and tabulations were made of the teachers' answers to the questions, and of their general comments. These tables are too voluminous to be reproduced, but their general indications may be briefly summarized.

1. The reports do not indicate any striking difference in the general level of teaching ability and practice in the X and C groups. A careful reading of the reports, coupled with our direct observation of classroom work, convinces us that if there is any difference it is slight and in favor of the C group.

2. There is, however, abundant evidence throughout the reports, confirmed by our direct observation, that the C

teachers were constantly exerting an anxious and unusual pressure on their pupils which was unlike anything that appeared in the X classes or in any normal classrooms that we have ever observed. By contrast, we got the impression both from the reports and our observations that the X teachers were dominated by enthusiasm without any of the anxious pressure which is so manifest in the C classes. As indicated in a preceding chapter, the anxiety of the C

Eastman Classroom Films

EXPERIMENTAL TEACHER'S REPORT — 3 EG.

City____________________Name of Teacher____________

Name of School______________Grade_____Topic__________

There are ten films in Geography. Each film is regarded as a topic. When all the work on a topic has been completed the teacher should fill out the following report. The report should be mailed to Thos. E. Finegan, Eastman Kodak Company, Rochester, N.Y.

What reading material was used in teaching this topic?

What supplementary reading material was available to pupils?

What suggestions were made as to the use of this supplementary material outside the lesson period?

In what parts of the lesson did the pupils seem most interested?

Make out a record of the reports which pupils make of reading aside from the lesson assignments. This includes books, magazines, and newspapers.

Make a report of the illustrative materials brought in by pupils, including clippings, pictures, exhibit articles, etc. Keep on file all of this material that does not have to be returned to the pupils.

Report all comments, questions, and other evidences of interest in the lesson that occur outside the class period.

teachers and the pressure which they exerted was very largely due to the sense of rivalry which developed early in the experiment.

3. One practice reported by many of the C teachers and by none of the X teachers undoubtedly gave the C students a specific advantage in the tests, namely, the practice of using multiple-choice, true-false, and completion questions in their weekly and daily quizzes. In some cases the

Eastman Classroom Films

CONTROL TEACHER'S REPORT — 3 CS.

City____________________Name of Teacher__________

Name of School______________Grade_____Topic__________

There are ten films in General Science. Each film is regarded as a topic. When all the work on a topic has been completed the teacher should fill out the following report. The report should be mailed to Thos. E. Finegan, Eastman Kodak Company, Rochester, N.Y.

What reading and pictorial materials were used in teaching this topic?

What supplementary reading and pictorial materials were available to pupils?

What suggestions were made as to the use of this supplementary material outside the lesson period?

In what parts of the lesson did the pupils seem most interested?

Make out a record of the reports which pupils make of reading aside from the lesson assignments. This includes books, magazines, and newspapers.

Make a report of the illustrative materials brought in by pupils, including clippings, pictures, exhibit articles, etc. Keep on file all of this material that does not have to be returned to the pupils.

Report all comments, questions, and other evidences of interest in the lesson that occur outside the class period.

C teachers reported that they made up lists of technical terms connected with each topic, and drilled the students on these terms. It is quite likely that these practices were partially stimulated by the anxiety mentioned above. Neither of these practices is mentioned by more than three or four X teachers.

4. A majority of the C teachers report the extensive use of many visual aids other than motion pictures, such as lantern slides, still pictures, diagrams, wall charts, etc. Only a negligible number of X teachers report the use of such aids. The reason for their not using these aids seems to be that they used all the available time trying to develop the rich offerings of the motion pictures.

5. The reports indicate that there was a tendency among X teachers to lean too heavily upon the films. This tendency was not very general, but appeared in two or three cities as a dominant factor in the results obtained from those cities, especially in the General Science classes.

Sample reports. The reports from some of the cities strikingly support these indications. Partly to illustrate this fact, and partly to show how these reports help to explain some of the deviations from the general rule that the X groups gain more than the C groups, summaries of the General Science reports from Cities E, H and K are presented below, with the answers of the X and C teachers arranged in parallel columns. These reports are not presented as typical for all cities, but only as examples of the types of reports which, together with our direct observations, led us to formulate the conclusions stated above.

The report from City E is almost unique; only one or two other cities contribute X reports which are nearly like it. The situation in City E has been mentioned in several preceding chapters, notably IV, VI, VII, and VIII. It will be recalled that in City E General Science classes, the C group

was superior to the X group in both the Comprehensive (Tables 14, 16 and 17) and Topical (Table 29) Tests; and that it was superior both in initial and final absolute scores and in gains. The following parallel summaries of the X and C reports from this city seem to us to be more than enough to account for the fact that the test results are out of line with the general rule of the superiority of the X groups.

City E. Summaries of Teachers' Reports

Experimental	*Control*
Question 1. What reading and pictorial materials were used in teaching this topic?	
X teacher reports that he has been in the habit of encouraging outside supplementary reading but that the records of this reading were kept only in the form of a pupil's book of clippings. He further states that various texts were available for supplementary reading but that these materials were little used in two of the topics and not used at all in the other eight. The X teacher, then, depended almost entirely upon the textbook for the sources of reading material or upon the clippings which pupils found.	In regard to supplementary reading C teacher says, "Much emphasis was placed upon this. We read extensively many different texts, magazines, newspapers, Current Science, World Book, Book of Knowledge." She mentions 44 specific books, magazines, or articles which she used in teaching the ten topics. At least six or seven of these were used in each unit.
Question 2. What supplementary reading and pictorial materials were available to pupils?	
Reports that he has encouraged pupils to bring in clippings, pictures, exhibits, etc., but that it was not compulsory. He says that about 50 per cent kept a book of clippings.	Reports the extensive use of slides and pictures in all topics studied. (The school system is one which has made extensive use of visual materials, yet the X teacher apparently used them not at all while the C teacher used them frequently.)

Question 3. What suggestions were made as to the use of this supplementary material outside the lesson period?

Reports that no suggestions were made at any time to pupils for the use of the supplementary material outside the lesson period.

C teacher comments as follows on suggestions which she made: (To the pupils) "I hope that you will keep this work in mind. I think that from time to time you will see mention made of it and will be able to explain phenomena through your knowledge of air pressure." . . . "Observe tools which you see from time to time — note whether or not they are pneumatic."

Question 4. In what parts of the lesson did the pupils seem most interested?

X teacher reports for every topic that he was unable to notice any difference in the pupil's interest in the various parts of the lesson.

For every topic the C teacher reports the parts in which the pupils were most interested.

5. Length and character of the report.

The X teacher wrote a report on each of the ten topics in answer to the above questions and *used in his entire report only 106 words.* Half of these words were those used to report that he had done nothing in the particular field mentioned.

The C teacher wrote a report of 2295 words, giving in detail the techniques which she used throughout the ten topics which were taught. The report indicates clearly the enthusiasm and interest which she took in her work.

It seems to us that under the conditions described in the summaries above, the X class had no real chance of success in competing with the C class. The teacher of the X class in City E can easily be identified as teacher number 41, whose attitude toward the experiment is so clearly indicated by his answers to the questionnaire set forth in Chapter VIII.

City H furnishes another instance of a deviation from the general rule which seems to be adequately explained by an analysis of the teachers' reports. In the parallel summaries below it seems clear that the C teacher was more active, used more books and readings, was more specific in giving

assignments and suggesting collateral readings, was more thorough in keeping an effective record of the activities of the children, provided more sustained incentives to continuing achievement, used more pictorial aids, including lantern slides, and was himself more genuinely interested in the topics than the X teacher. This does not mean that the X teacher was ineffective. On the contrary, both X and C teachers in City H were excellent; the gains in both X and C classes were far above the average gain for all classes in all cities. It does mean that the C students in this city enjoyed such extraordinarily exceptional teaching as to account for the deviation from the general rule mentioned above.

City H. Summaries of Teachers' Reports

Experimental	*Control*
1. Reading and pictorial materials used.	
Used 11 different books and magazines.	Used 35 different books, magazines, and periodicals. Pictures were extensively used in each topic.
2. Supplementary reading and pictorial material.	
Twenty-four different books and magazines were available. Encouraged reading but kept no record of it.	Thirty-four different books and magazines were available. Encouraged reading and kept a record of it.
3. Suggestions made as to use of supplementary materials outside the lesson period.	
Children were encouraged in so far as possible to do any experimental work that they could at home. Watching furnace man or janitor at home suggested. In making reports it was suggested that library books be used. Actual use of any instrument spoken of as illustrating principles involved in	Children encouraged to obtain information on evolution of stove, advantages or disadvantages of one mode of heating over another, transference of heat; and were directed to make conclusions as to best methods of heating. . . . Children advised to read; to study, to perform experiments whenever possible; to bring

the lesson was investigated by pupils at teacher's suggestion. Suggested that boys go to library and get these books, or use them in the school library after school, in order to answer the questions suggested by the pupils' guide and write up topics.

in all information helpful to understanding of air; to jot down questions that arise in their minds while reading. . . . Advised to find underlying principles and methods of operation of instruments (assigned) worked by compressed air; and to make diagrams wherever possible. . . . Advised to note changes continuously taking place because of the operation of the water cycle; to make illustrations of work wherever possible; and to jot down questions when subject is not clear. . . . Instructed to study topics assigned; to consult several books on same topic; to compare subject matter; to draw own conclusions; to jot down questions when subject matter is not clear; and to illustrate wherever possible. . . . To study topic assigned; to consult more than one book on topic; to perform experiments wherever possible, and to illustrate experiments. . . . To study origin of rocks; to consult more than one book; to compare subject matter; to examine pictures carefully; to look in own environment for application of things studied. . . . To consult more than one book on subject; to obtain clear ideas; to learn to explain process from beginning to end; to collect specimens of objects studied; to look for illustrations in own environment. . . . To use index; to examine illustrations; to be able to discuss topic assigned intelligently. . . . To note how care of young trees must be painstaking and as gentle as care of infant; to read about kindred topics; to obtain clear ideas and to be able to reproduce them.

4. Parts of lesson in which pupils seemed most interested.

The experiments in atmospheric pressure. . . . The diagrams in hot air heating. . . . The class demonstrations done by the teacher left the greatest impression. . . . In the parts of the film in which they were able to identify what they had previously learned through another film. . . . In evaporation and condensation as a means of producing rain. . . . The animated diagrams thrown on the screen seemed very impressive. . . . The gradual evolution of the heating systems seemed quite thrilling to the boys.

Interested throughout. . . . In parts relating to fountain pens, soda water straws, and flying. . . . In fact the subject was intensely interesting to them throughout. . . . In the parts relating to air brakes, and to machines and tools used for building purposes. . . . In the formation of clouds and in the work of glaciers. . . . In introduction, in description of appearance and surroundings of N.Y.C.; in slides; in growth; in possible pollution and in aëration and chlorination, and in types of men concerned in construction and operation of system. . . . Most interested in results of experiments; in training of bacteriologists; in rapid increase of bacteria; and in discussion of treatment of goiter with iodine. . . . Making of concrete; uses of marble; pictures of application of products of limestone. . . . In glass making, pottery making and brick making; and in the materials used in the construction of a brick house. . . . In soil erosion; in prevention of forest fires, in effect of wasteful cutting; in value of a reforestation project. . . . In damage done by insects; in control and extermination of them; in grafting and its advantages; in a school garden plan. . . .

5. Length and character of report.

Report contained 525 words. Made no report on outside reading of pupils. No report on illustrative materials brought in by pupils.

Report contained 1567 words. Gave detailed information on outside reading of pupils. Pictures were used extensively and high degree of pupil interest indicated throughout the topic by these statements. . . . Brought butterflies and moths for identification. Ques-

tioned regarding their harm to crops. Related stories of decay of fruits. . . . Children intensely interested and manifested desire to discuss subject at any time and during all related subjects. . . . Reported seeing memorial trees; related stories of forest fires, etc. . . . Children brought pictures of reservoirs, filters, aërators, etc.; brought supplies from their medicine chests to ascertain whether they can be used in the purifying of water. Forced to suppress endless tales of death from typhoid resulting from contaminated water. . . . Interest rife even upon entering school before nine, and before one. . . . Children question whether Vermont flood was due to operation of water cycle; whether trees planted along banks of rivers would prevent them (the rivers) from overflowing, etc., etc. Comments on subway use of compressed air; on Holland tunnel use of it. Reports of observations made while watching buildings in vicinity in course of construction. Reported seeing airplanes, Zeppelin Los Angeles. Questions regarding them asked, answers from classmates were quickly forthcoming.

The X and C reports from City K are much more evenly matched in their indications, and are more nearly typical of the reports from a majority of the cities. The most notable difference appears in the last part of the following summary. Something approximating the "drill" method is mentioned by many C teachers, and by practically none of the X teachers. We believe that the type of drill mentioned here gives the C students an advantage with the types of tests we have used which is not matched by an equally large

educational advantage. We believe it to be the same kind of advantage which practice with the specific forms of questions used in our tests gives.

City K

Experimental	*Control*
1. Reading and pictorial materials used.	
Thirty different books, articles and magazines were used.	Method of enumerating materials made it impossible to determine exactly the number of books and pamphlets used. The number, however, was not less than 50.
2. Supplementary and pictorial material.	
Occasional reference to some science topic. No record kept. Lack of time. Magazine of Natural History, Bird Lore, Science Invention, Popular Science and Mechanics, and Set of Encyclopedias on Natural History are kept on teacher's table for use by students. Wide variety of materials apparently available.	All of materials above were available to students. These materials were collected from school library, public library, U.S. Forest Reserve Office, State College, and other sources.
3. Suggestions made as to use of supplementary materials outside the lesson period.	
Suggested for use in special reports that each topic in study pamphlet should be used as a basis for study and references from the available books noted for each subject. Pupils looked up as many references as possible about each topic. Questions were given to be answered by consulting the references. Special booklets were made for National Forestry Week.	On all assigned work the pupils were allowed to take sources home. References were given for further guidance. Supervised study plan was used and outside reading was purely voluntary. However, extra credit on the pupil's grade was given for this outside reading and this doubtless acted as a very strong incentive to do extra outside work.
4. Parts of lesson in which pupils seemed most interested.	
How far apart seedlings should be planted. Danger of insects and	Demonstrations, experiments, charts. In grafting. Exhibits of

moths to trees. . . . How trees were grown to reforest devastated areas. . . . Making of glass. . . . Automatic cutter. Noticed compressed air devices. Construction work of building. Mixing of cement. . . . Goiter. Filtration of water. The daily testing of water. The aëration and chlorination of water. The tunnel underneath Manhattan and the numerous vertical risers. Types of clouds. Water level. Railway air brake. Ventilation.

various kinds of grafts were prepared.

5. Length and character of report.

Eleven hundred and eighty-six words were used. Both reports give indications that the teachers were interested in their work and did their best to accomplish results. X teacher got a group of children that she had not taught before and said that they "had apparently had little experience in the project way of teaching, or of doing any special outside work — but after a few weeks the class began to bring in suggestions and reports and exhibits from the outside and their notebooks were better prepared and their oral reports were better."

Eleven hundred and sixteen words were used. Part of the strength of the C teacher doubtless lay in the utilization of the following method of teaching. She says, "A series of questions covering the unit thoroughly and including a technical vocabulary relating to the unit is made out and mimeographed. Each student pastes a set of these questions in his note book and the correct answers are learned." . . . Each unit was ended by a review, clarification of items not clear, and a drill.

EXHIBITS OF PROJECT WORK

About two weeks before the experiment ended the X and C teachers in all cities were asked to send to New York City exhibits of the projects completed by their students. They were asked to include exhibits on each of the ten topics. The result was that about a month after the experiment ended large packing boxes and crates of exhibits began to arrive. Five average sized rooms were filled to overflowing before half of the boxes had been opened.

Character of exhibits. The exhibits included a wide assortment of evidences of pupil activity, from themes, notebooks, display books, reports, clippings, pamphlets, diagrams, drawings, maps, and pictures to elaborate posters and charts, and skillfully constructed models and miniatures of windmills, dairies, schooners, farm implements, farmhouses and fields of cotton, corn and wheat, coal mines and mining machinery, railroads, silos, show cases of actual samples of derivative products of corn, cotton, coal, etc., and dozens of other interesting and highly instructive and thought-provoking displays of knowledge, understanding, and ingenuity.

Quantity of exhibits. An inventory of all exhibits received listed more than 5000 separate and labeled articles. All twelve cities sent in exhibits, but in no case were all the available and completed projects of students sent in, and there were some schools in several cities that were not represented in the exhibits at all. Some of these schools did excellent project work, according to the teachers' and superintendents' reports; and others did little or none. We had no means of ascertaining to what extent the exhibits received represented the X and C groups, either as to quantity or quality of project work done, and it is therefore unsafe to make any comparisons of X and C groups on the basis of the exhibits sent to us.

Indications of exhibits. The main value of the exhibits for the purposes of this experiment is to show concretely and convincingly that both X and C groups did good educational work during the experiment. It was in no sense an interruption of profitable school work; on the contrary, all the evidence available indicates that both X and C groups did better and more work during the experiment than before. In several of the cities the administrative officers in charge of the experiment remarked that they had never seen so

much good project work undertaken and carried out by pupils as in this experiment by both X and C groups.

In at least two cities these officers attributed the increase in quantity and quality of project work to the direct and indirect influence of the experiment. They wrote that the work in both X and C groups was noticeably better than usual, but that the improvement appeared to be much greater in the X than in the C classes. One associate superintendent, who carefully visited and inspected the X and C classes in his city throughout the whole period of the experiment, wrote that from the very beginning of the experiment he observed an unprecedented amount and quality of projects completed by the X students. One of the directors of the experiment visited his office during the fifth week of the experiment and was shown quite an exhibit of articles made by X children — wooden and metal models of tractors, scythes, flails, silos, etc. This Associate Superintendent later wrote that he believed most of the exhibits sent in by the C classes were rushed to completion *after* the request to send exhibits to New York City was transmitted to the C teachers near the end of the experimental period. Our own observations in that city confirm his judgment that the project work assumed no prominence in the C classes comparable with that in the X classes until the last two weeks of the period. In this connection, we may recall, as additional confirmatory evidence, the answers of the X teachers to Question 4 of the questionnaire (Chapter VIII, pages 156 to 157, above). Sixty-three per cent of the X teachers say that the films stimulated their students to undertake and complete projects to a greater extent than they had ever observed before, and 23 per cent say that their students did not have time to complete all the projects which the students wanted to undertake as a result of instruction with the films.

Plate IV. Some of the Exhibits Received

Plate V. More Exhibits

Plate VI. A Close-up of Part of an Exhibit

PLATE VII. ANOTHER CLOSE-UP

Photographs of exhibits. The accompanying plates are presented as a mere suggestion of the quantity and character of the exhibits of projects completed by students in this experiment. Since it was not possible (for the reasons noted above) to use the exhibits received as a basis for comparing the X and C groups, the X and C products are mixed indiscriminately in these illustrative photographs.

Plate IV, showing some of the exhibits received, is presented merely to illustrate the character of the exhibits sent in. The vast quantity of materials sent in cannot be adequately indicated by means of pictures. This photograph displays mainly posters and notebooks, but a number of concrete objects may be distinguished near the center. The long object leaning against the wall is a flail, constructed by a youngster who became particularly interested in the evolution of wheat-growing and bread-making methods. On the table immediately behind the lower end of the flail may be distinguished a box containing actual samples of sand, clay and other building materials. The by-products of wheat and cotton are displayed in a variety of ways. In the lower right-hand corner may be seen portions of charts illustrating a water-purifying process and the structure of a hot water furnace.

Plate V shows other exhibits received from cities participating in the experiment. Posters again predominate in this display, but a number of concrete objects constructed by pupils may be seen on the tables.

Plate VI, a detail from Plate V, shows in top center the map of the United States with the cotton belt outlined with bolls of cotton, and the centers of other industries indicated in writing, notably wheat, iron, coal, and cod-fishing. Dairying and cattle-raising areas are indicated by pictures pasted on the map. On the table may be seen various concrete objects constructed by the students. At the left, a harrow, a

bale of cotton, and a display-case showing a cotton bud, a cotton bloom, a green cotton boll, and an open fully ripe boll of cotton can be seen. In the center are seen some wooden models of wagons, tractors, a flail and other farm implements.

Plate VII, another detail from Plate V, shows various objects constructed by the children. The blade of the large scythe is made of iron and was constructed by a student on his own initiative and without help, so far as we know. A cradle scythe may be distinguished to the right of the house and water wheel. Immediately above may be seen the sails of a model of a schooner. A pitchfork, hay-rake, dory with oars, and silo may be easily identified.

Plate VIII portrays the classroom of an X teacher in a large eastern city. Notebooks and collection books of the students are seen on the desks and a part of their completed projects in the corner of the room. The classes taught by this teacher did more project work than we observed in any other class participating in the experiment.

Plate IX is a detail from Plate VIII and shows portions of the wheat, cattle, and cotton exhibits. Notice the flour mill and the elevator tower in the left center foreground. In the center foreground appears a very elaborate model of a cattle ranch, showing stockades, houses, animals, wagon, and what was evidently intended to represent a cattle train. In the right foreground one notes a cotton farm with house and cotton field. The construction of cattle ranches and cotton farms by children who have never been within a thousand miles of either is educationally significant.

Plate X is another detail from Plate VIII and depicts coal mine models with galleries and tunnels at various levels and miners at work in each.

Plate XI, an additional detail from Plate VIII, shows the notebooks and collection books put together by one child

PLATE VIII. ONE OF THE EXPERIMENTAL CLASSROOMS

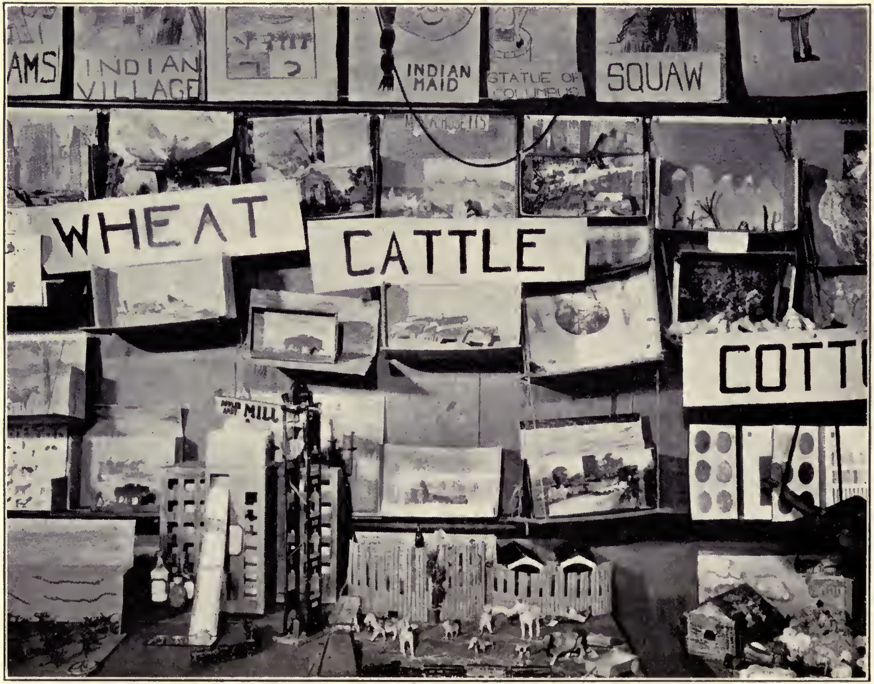


Plate IX. Exhibit — Wheat, Cattle, and Cotton

Plate X. Exhibit — Coal Mining

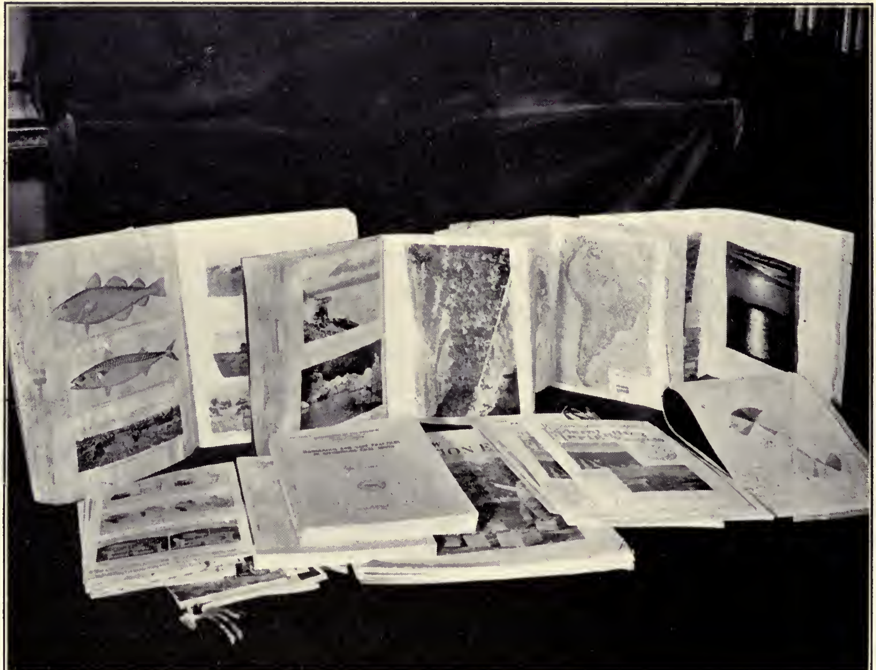


PLATE XI. NOTEBOOKS AND SCRAPBOOKS

during the course of the experiment. Many of the children in this classroom made collections of notes and pictures almost as extensive as the one pictured here. In this picture, the five books standing open are each about two inches thick and were put together by this one youngster in less than three months. The pamphlets and printed reports shown are only a fraction of those used and consulted by this student.

In Plate XII is shown the cod-fishing exhibit in the classroom pictured in Plate VIII. All the objects in the display were constructed by the children. The schooner models are especially good, as were also the three dimensional illustrations of various phases of the cod-fishing process.

SUMMARY

1. A careful analysis of the X and C teachers' reports made at the end of instruction on each topic indicates (*a*) that the general level of teaching ability and practice was about equal in the X and C classes; (*b*) that the C teachers exerted themselves energetically and put constant pressure on their students to make a good showing on the tests; (*c*) that some of the C teachers gave their classes extensive practice with the types of tests used in this investigation; (*d*) that the C teachers used visual aids other than motion pictures extensively; and (*e*) that in several instances, notably in General Science classes, the X teachers leaned too heavily upon the films.
2. Summaries of the X and C teachers' reports from three cities illustrate the indications mentioned above.
3. An extensive collection of exhibits of the project work of the X and C students in all twelve of the coöperating cities shows that much excellent work of this sort was done by both X and C classes. The collection does

not afford a basis for comparing X and C students either as to quantity or quality of projects completed; but from other sources we infer that the X students were slightly superior in project work.

4. Parts of the exhibits are illustrated in several plates.

Plate XII. Exhibit — Cod Fishing

CHAPTER X

NATURE OF THE FILM CONTRIBUTIONS

Direct and Indirect Outcomes — Analysis of Topical Test Scores: General Science — Geography — Summary.

The preceding chapters have dealt with the general question of the comparative merits of instruction with the aid of the motion picture film and of instruction without the films. The comparison has been made between the scores of the X group and the C group on each of the three series of tests and on all three series taken together. The comparison has been made by cities and by topics. These comparisons have shown beyond question that, under the conditions which obtained in this experiment, which probably reflect normal school conditions reasonably well, the use of the films materially increased the effectiveness of instruction. There were exceptions to this general finding, but the exceptions did not impair the weight of the general evidence.

We might rest the case with this general finding, because with this conclusion the primary purpose of the experiment and of the report has been served. But the data furnished by the three types of tests that we have used lend themselves to interpretations which throw some light on the nature and relative importance of the contributions made by the films. These interpretations seem worthy of a brief statement, not because they are conclusive, but because they indicate illuminating contrasts and suggest concretely types of research which would be of great value in guiding the production of good classroom films.

DIRECT AND INDIRECT OUTCOMES

We have already explained in preceding chapters the nature of the three types of tests used in this experiment.

(1) The Comprehensive Initial Tests, Parts 3 and 4, were also given as Final Test, Parts 1 and 2 (i.e., Initial and Final Test C2), and thereby gave us a measure of the relative gains of the X and C groups in terms of the usual goals of education, emphasizing the organization of knowledge, cause-effect sequences, reasoning and judgment. (2) Final Parts 3 and 4 of the Comprehensive Tests (C3) were given only at the end of the experiment, and gave us measures of X and C achievement with special emphasis on knowledge of concrete things and processes. (3) The Topical Tests, given at the end of each two weeks throughout the experiment, gave us measures of the immediate recall powers of the X and C groups with emphasis on description of concrete objects and processes, but including some questions requiring explanation of causes, effects, and relations.

The first of these three types of tests, then, emphasizes what may be called the indirect outcomes of instruction — the results of interpretation. The second and third emphasize the direct contribution of instruction — knowledge of facts and things which are the materials of thinking. Inspection of these tests (see Appendix) will show that while they overlap in measuring these functions, since all three to some extent measure the indirect, interpretative outcomes of instruction, the Topical and Final Comprehensive Tests (C3) do emphasize the direct outcomes of instruction.

The results of these three types of tests have already been summarized in a preceding chapter in Table 33. When the superiority of the X group is stated as a percentage of the standard deviation of the scores of both X and C groups together, it appears that the X group is more superior in the tests measuring the more direct and immediate outcomes; but when the X superiority is expressed as a percentage of the average gain or average score of the C group, the superiority of the X groups appears to be greater in the test

measuring the more general and indirect outcomes of instruction, notably in Geography (Table 33). Without going into the technical complexities regarding the merits of these two ways of expressing the degree of X superiority on the three types of tests, we believe that the use of the standard deviation as a unit is more appropriate for the comparison we are making, and that the indication of greater X superiority in the immediate and direct outcomes is in consonance with all other available evidence and with a common-sense view of the matter.

Analysis of topical test scores. The study of the relative effectiveness of the films in the concrete and abstract phases of the courses of study can be carried a step further by classifying the individual questions of the Topical Tests into types and comparing the scores of the X and C groups on each of the different types.[1]

The individual questions of the Topical Tests in General Science and Geography, together with the mean scores of the X and C groups on each question, and the percentage differences between the means of the two groups, are reproduced in Appendix IV and Appendix V. These appendices give the basic data for our analysis.

General Science. In Table 41 the questions of the Topical Tests in General Science are arranged according to degree of superiority of the scores of the X group, and are

[1] An attempt was made to classify the items of the Comprehensive Test in the same way. It was discovered, however, that the items were already classified about as exactly as they could be classified by inspection. That is, Parts 1 and 2 of the Final Test contain items which are largely abstract in character, while Parts 3 and 4 are almost entirely concrete in character. The contrast which has already been drawn in Table 33 between the relative effectiveness of the films as measured by these tests, therefore, gives us all the information on this problem which the Comprehensive Tests can furnish.

Since the Topical Tests contain items of a more varied nature, calling for different types of responses, they can be subjected to further analysis.

TABLE 41. COMPARISON BETWEEN THE SCORES OF THE X AND C GROUPS ON EACH QUESTION OF THE TOPICAL TESTS IN GENERAL SCIENCE

Columns headed "Topic" and "Question" designate the individual questions. The letters under "Type of Question" are to be interpreted as follows: D means a "Describe" question, E an "Explain" question, F a "Fact" question, Dm a "Diagram" question, and M a "Map" question. The figures in the last column represent the percentage difference between the average scores of the X and C groups. If the X group is superior the number is positive. If the C group is superior the number is negative.

$$\text{Superiority} = \frac{\text{Film Score} - \text{Control Score}}{\text{Control Score}}$$

Topic	Question	Type of Question	Percentage Superiority of X Group	Topic	Question	Type of Question	Percentage Superiority of X Group
Sand & Clay	7	D	+480.0	Atmospheric Pressure	6	D–E	+25.0
Purifying Water	7	D–E	+150.0	Purifying Water	8	D	+25.0
Limestone & Marble	1	D	+138.5	Sand & Clay	1	F	+24.0
Compressed Air	4	D–E	+120.0	Water Cycle	5	E	+20.0
Sand & Clay	2	D	+118.2	Purifying Water	2	F	+18.7
Planting of Trees	10	D	+116.7	Water Cycle	9	F	+17.4
Sand & Clay	10	D–E	+100.0	Compressed Air	7	D–E	+16.7
Atmospheric Pressure	9	D	+88.6	Hot Air Heating	8	D	+15.4
Purifying Water	1	D	+78.6	Atmospheric Pressure	5	F	+14.3
Compressed Air	6	D	+70.6	Purifying Water	9	D	+14.3
Reforestation	4	D	+61.5	Purifying Water	6	D	+13.3
Sand & Clay	3	D	+54.5	Sand & Clay	6	F	+11.1
Limestone & Marble	9	D	+54.5	Sand & Clay	9	D	+10.5
Atmospheric Pressure	8	E	+50.0	Reforestation	3	D	+10.0
Purifying Water	3	D	+50.0	Water Supply	2	M	+9.7
Sand & Clay	8	F	+41.7	Atmospheric Pressure	2	Dm	+9.5
Planting of Trees	5	D	+38.5	Water Supply	9	F	+9.4
Purifying Water	4	E	+33.3	Planting of Trees	2	E	+9.1
Limestone & Marble	4	D	+33.3	Planting of Trees	9	D	+8.8
Reforestation	6	E	+28.6	Sand & Clay	4	F–E	+8.6
Compressed Air	1	Dm	+27.5	Hot Air Heating	6	D	+7.7
Reforestation	5	D	+27.3	Compressed Air	5	D	+7.7
Reforestation	11	D	+26.1	Purifying Water	5	D	+7.1
				Water Supply	7	D–E	+6.3

TABLE 41 (*continued*).

$$\text{Superiority} = \frac{\text{Film Score} - \text{Control Score}}{\text{Control Score}}$$

Topic	Question	Type of Question	Percentage Superiority of X Group	Topic	Question	Type of Question	Percentage Superiority of X Group
Reforestation	10	E	+5.0	Reforestation	9	F	−7.7
Water Supply	1	E–D	+5.0	Water Supply	3	D–E	−8.3
Planting of Trees	7	F	+4.3	Water Supply	4	D–E	−8.6
Planting of Trees	8	D	+4.0	Water Cycle	3	E	−9.1
Hot Air Heating	1	Dm	0.0	Reforestation	8	F	−9.5
Atmospheric Pressure	4	E	0.0	Planting of Trees	11	F	−9.5
Atmospheric Pressure	7	Dm	0.0	Reforestation	2	E	−11.5
Compressed Air	3	E	0.0	Limestone & Marble	2	F	−11.8
Compressed Air	8	F	0.0	Hot Air Heating	7	E	−12.5
Water Supply	5	F	0.0	Water Supply	6	D–E	−12.5
Water Supply	8	F	0.0	Water Cycle	7	F	−15.4
Limestone & Marble	5	F	0.0	Reforestation	1	D	−16.0
Limestone & Marble	7	F	0.0	Compressed Air	2	E	−16.7
Limestone & Marble	10	F	0.0	Water Cycle	4	D–Dm	−18.2
Reforestation	7	E	0.0	Atmospheric Pressure	3	E	−18.9
Planting of Trees	1	F–E	0.0	Purifying Water	10	F	−19.0
Planting of Trees	3	E	0.0	Hot Air Heating	4	E	−20.0
Planting of Trees	6	E	0.0	Limestone & Marble	3	E	−21.4
Hot Air Heating	3	D	−4.2	Water Cycle	2	F	−22.2
Planting of Trees	4	E	−5.9	Limestone & Marble	8	F	−23.1
Hot Air Heating	9	E	−6.3	Sand & Clay	5	D	−23.1
Limestone & Marble	6	F	−7.0	Water Cycle	8	F	−24.0
Water Cycle	6	E	−7.7	Water Cycle	1	F	−25.0
				Water Supply	10	E	−28.6
				Atmospheric Pressure	1	D–Dm	−29.3
				Hot Air Heating	5	Dm	−34.6
				Hot Air Heating	2	E	−41.7

also classified into types. The first question in Table 41 is No. 7 on the topic "Sand and Clay": "Describe how grindstones are quarried and shaped"; it is a D (describe) question, and the numerical average score of the X group exceeds the score of the C group to the extent of 480 per cent of the C group average, i.e., 2.9 as against 0.5 score points.

The "describe" questions, indicated in the table by the letter "D," demand a description of some concrete object or action. The "explain" questions, designated by the letter "E," call for an explanation or a comparison. An example of this type of question is, "What causes convection currents, and explain." Such a question requires the child to carry on a process of generalization or abstract thinking. The letter "F" designates those questions which require the child to give some fact he has learned. An example is, "Tell what slate is and how it is obtained." The symbol "M" refers to a question which requires the child to draw a map. Questions which call for a diagram are indicated by the symbol "Dm." Finally there were a considerable number of double-barreled questions, requiring two types of responses. These are designated by appropriate pairs of letters, "DE," "FE," and "DDm." This classification is not very exact, since we do not know just what mental processes are set up in a child's mind by a question, but it does doubtless set up genuine group distinctions.

A general inspection of the table shows that the questions on which the X group is superior are much more numerous than are the questions on which the C group is superior. This agrees with the general fact that the X group is superior on the test as a whole. Again, the X group is superior by larger amounts than is the C group. These facts are what we should expect from our previous comparison. But the

most significant fact brought out in this table, and the one which has not appeared before, is that the X group is superior more largely in the descriptive than in the explanatory questions, while the superiority of the C group is confined almost entirely to questions of the explanatory type. Before enlarging on this fact the data may be presented in another form.

TABLE 42. COMPARISON OF THE PERCENTAGE DIFFERENCES OF SCORES OF THE X AND C GROUPS ON THE DIFFERENT TYPES OF QUESTIONS IN GENERAL SCIENCE

Type of Question	No. on which C Group is Superior	No. on which X Group is Superior	No. on which X and C Groups are Equal	Total	Sum of Percentages in Favor of C Group (a)	Sum of Percentages in Favor of X Group (b)	Average Difference $\frac{\text{Col. }(b)-\text{Col. }(a)}{N}$
Describe	3	26	..	29	43.3	1560.7	52.3
Explain	12	6	5	23	200.3	146.6	−2.3
Facts	11	8	6	25	174.2	140.9	−1.3
Describe and Explain	3	7	..	10	29.4	423.0	39.4
Diagram	1	2	2	5	34.6	37.0	0.5
Facts and Explain	..	1	1	2	....	8.6	4.3
Describe and Diagram	2	..	..	2	47.5	....	−23.8
Map	..	1	..	1	....	9.7	9.7
Total	32	51	14	97	529.3	2326.5	18.5

Table 42 shows that on the questions calling for description the X group is superior on twenty-eight questions while the C group is superior only on three. The average superiority of the X group on each of the several items is 52.3 per cent of the C mean score on these items. On the questions calling for explanation and comparison the film group loses its superiority altogether. The distinctive immediate

contribution of the film to concrete experience is here clearly indicated.

The last four groups in Table 42 contain so few items that little reliance can be placed upon them. It may, however, be worth while to comment on one of the questions requiring a combination of description and diagramming. The question reads: "With the aid of a diagram explain just how you would make a mercury barometer." The C group made superior scores on this question to the extent of 29.3 per cent of the C mean score on this question. The question calls for a description of the process by means of a diagram, and for an explanation of the steps which are taken in making the instrument. It is probable that many of the C groups either witnessed the construction of a mercury barometer by the teacher or took part in constructing one themselves. It seems to be a natural inference that children can understand the construction of such simple pieces of apparatus as well or better from actual demonstration or experiment than from seeing a motion picture of its construction. This does not justify a general negative criticism of motion pictures, but it does enforce the conclusion that the immediate and direct contributions of the motion picture, so far as they are measured by these tests, are specific and particular, and that it is the business of experimental education to discover the nature of these direct contributions.

Geography. The data on the individual questions in the Geography Topical Tests are shown in Tables 43 and 44, which are parallel both in form and significance to Tables 41 and 42, respectively.

It will be observed that the results of the tests in Geography agree closely with those in General Science. The frequency of the different types of questions differs somewhat. There is a smaller proportion of questions requiring

explanation or the recitation of facts in the Geography tests than in the General Science tests. This difference is probably in accord with the nature of the two subjects — Geography being of a descriptive nature and Science of an explanatory nature. This difference in the nature of the subjects and of the questions may also account for the fact that the film group exhibits apparently greater superiority in the Geography tests than in the Science tests.

There is the same contrast between the relative achievement of the X and C groups on the questions of a descriptive and an explanatory type as in the General Science tests, only the contrast is somewhat less striking. On the descriptive questions in Geography the film group is not quite so superior as in the descriptive questions in General Science. On the questions calling for explanation and comparison there is a slight average superiority on the part of the X group, but this is due to the preponderating superiority on a few questions. The C group is superior in ten of the fifteen questions in this category. On the questions which call for the recital of facts the X group is superior both in average score, and on a majority of questions, but its superiority is much less than in the questions calling for description. On the three map questions the X group is decidedly superior. The results of this analysis of the questions on the topics in Geography are clear and decisive.

The striking and uniform contrast between the success of the children who saw the motion pictures as measured by the descriptive questions and as measured by the questions requiring explanation or the recitation of facts indicates that the films should be designed and used for a specific *immediate* purpose. In this way, the more general and indirect contributions will be enhanced. The immediate purpose is to give the child clear and definite notions of concrete material objects and their movements, and to reveal

TABLE 43. COMPARISON BETWEEN THE SCORES OF THE X AND C GROUPS ON EACH QUESTION OF THE TOPICAL TESTS IN GEOGRAPHY

Columns headed "Topic" and "Question" designate the individual questions. The letters under "Type of Question" are to be interpreted as follows: D means a "Describe" question, E an "Explain" question, F a "Fact" question, Dm a "Diagram" question, and M a "Map" question. The figures in the last column represent the percentage difference between the average scores of the X and C groups. If the X group is superior the number is positive. If the C group is superior the number is negative.

$$\text{Superiority} = \frac{\text{Film Score} - \text{Control Score}}{\text{Control Score}}$$

Topic	Question	Type of Question	Percentage Superiority of X Group	Topic	Question	Type of Question	Percentage Superiority of X Group
Bituminous Coal	8	D	+400.0	Bituminous Coal	2	D	+29.2
Corn	1 (3)	D	+100.0	New England Fisheries	4	M	+28.0
Iron Ore to Pig Iron	6	D	+88.9	Cotton Growing	5	D	+26.1
Bituminous Coal	9	E	+75.0	New England Fisheries	2	D	+25.9
Cotton Growing	6	D	+70.6	Cotton Growing	8	E	+25.0
New England Fisheries	7	D	+66.7	Iron Ore to Pig Iron	4	D	+25.0
Cotton Growing	2	D	+66.7	Irrigation	5	E	+25.0
Corn	1 (4)	D	+63.0	Irrigation	6	F	+25.0
Cattle	6	D	+61.9	Irrigation	7	D	+23.8
Bituminous Coal	5	D	+58.3	Irrigation	4	D	+22.2
Bituminous Coal	6	D	+50.0	Iron Ore to Pig Iron	2	D	+22.2
Wheat	1	D	+33.3	Cattle	4	F	+20.0
Iron Ore to Pig Iron	3	D	+31.6	Cotton Growing	1	D	+19.2
From Wheat to Bread	1	D	+31.25	Bituminous Coal	7	D	+18.75
Corn	4	D	+30.8	From Wheat to Bread	3	E	+18.2
Cotton Growing	3	D	+30.0	Irrigation	1	M	+18.2
Wheat	5	F	+30.0	Wheat	3	D	+14.3
Iron Ore to Pig Iron	8	M	+30.0	Irrigation	2	F	+14.3
New England Fisheries	6	D	+29.4	Irrigation	8	D	+14.3

Table 43 (*continued*)

$$\text{Superiority} = \frac{\text{Film Score} - \text{Control Score}}{\text{Control Score}}$$

Topic	Question	Type of Question	Percentage Superiority of X Group	Topic	Question	Type of Question	Percentage Superiority of X Group
From Wheat to Bread	4	D	+12.8	Irrigation	9	E	0.0
Wisconsin Dairies	2	D	+11.1	Bituminous Coal	1	F	0.0
Cattle	5	D	+11.1	Iron Ore to Pig Iron	1	D	0.0
Iron Ore to Pig Iron	5	D	+11.1	Cotton Growing	9	F	−5.6
Corn	5	D	+10.5	New England Fisheries	1	D	−5.7
New England Fisheries	5	E	+5.3	Corn	6	F	−5.9
Cotton Growing	7	D	+4.3	Wisconsin Dairies	3	E	−6.7
Wisconsin Dairies	4	D	+4.0	Wheat	7	E	−6.7
Cotton Growing	4	F	+4.0	New England Fisheries	3	E	−7.1
Bituminous Coal	4	F	+2.4	Wisconsin Dairies	5	D	−7.1
Wisconsin Dairies	1	D	0.0	From Wheat to Bread	6	E	−7.1
Wheat	2	D	0.0	Iron Ore to Pig Iron	7	E	−7.1
Wheat	4	E	0.0	Bituminous Coal	3	D	−9.1
From Wheat to Bread	2	E	0.0	Corn	3	E	−9.5
From Wheat to Bread	5	E	0.0	Wheat	6	E	−10.0
Cattle	1	D	0.0	Bituminous Coal	10	E	−11.1
Cattle	2	D	0.0	Wisconsin Dairies	6	E	−11.8
Cattle	7	E	0.0	Corn	1 (2)	F	−11.8
Corn	1 (1)	E	0.0	Corn	2	D	−13.0
Cotton Growing	10	E	0.0	Cattle	3	E	−20.0
Irrigation	3	D	0.0				

Table 44. Comparison of the Percentage Differences of Scores of the X and C Groups on the Different Types of Questions in Geography

Type of Question	No. on which C Group is Superior	No. on which X Group is Superior	No. on which X and C Groups are Equal	Total	Sum of Percentages in Favor of C Group (*a*)	Sum of Percentages in Favor of X Group (*b*)	Average Difference $\frac{\text{Col. }(b)-\text{Col. }(a)}{N}$
Describe	4	34	6	44	34.9	1518.3	34.5
Explain and Compare	10	5	7	22	97.1	148.5	2.3
Facts	3	6	1	10	23.3	95.7	7.2
Map	0	3	0	3	0.0	76.2	25.4
Total	17	48	14	79	155.3	1838.7	21.3

to the child how things look — particularly how things look in action. The films serve to help to give the child's experience and thinking the concrete foundation which it needs, in respect to the special kind of concreteness which they are adapted to give. That the child needs this concrete foundation for his thinking is a cardinal doctrine of modern education. There is neither the space nor the need in this discussion to argue this point.

But it is also a fair assumption that concrete experience is not the final goal of education. It exists largely as a means to thinking. It is valuable because it makes thinking sound and substantial. If this is the case is it not sufficient to test the quality of the child's thinking? Will we not thus test both thinking and its foundation in concrete experiencing — the one directly and the other indirectly? In other words, are not our explanatory questions an adequate test of both the concrete and the abstract elements in the child's education, and if the film group is superior in one should it not also be equally superior in the other?

This conclusion hardly follows from the premises. It is

true that in the long run sound thinking depends on adequate direct experience with the physical world. But we should not expect a very large immediate improvement in ability to interpret concrete experience. The development of thinking is a gradual affair, and this whole experiment lasted only twelve weeks. Moreover, the contrast between real thinking and counterfeit thinking is not always easily detected or measured. A child may be able to recite a fact which has been told him in language as glibly as one who has observed the fact directly — or even more so. In some cases the child's previous experience with similar objects may make a fact which is given him verbally as completely understandable as is the fact which he observes. For these reasons it would hardly be fair to demand that the value of motion pictures be measured wholly by the indirect method. The direct measure is the most significant.

In spite of this limitation the X groups, on the whole, made superior scores even on the questions requiring explanation. In spite of the initial advantage of the C group in intelligence and achievement (Tables 14 and 15), they were in no case markedly superior. This is the more noteworthy when we consider the conditions which obtained in the experiment. The X group spent at least forty-five minutes and probably more, of the time devoted to each topic in looking at the film. This constituted roughly 35 per cent of the total time in Geography and 20 per cent of the total time in General Science. The C group spent varying amounts of this time in discussion, consisting largely of explanation, comparison, and recitation of facts. Hence the fact that the X groups are at least equal to the C groups on questions requiring explanation and the recitation of facts argues that their concrete experience not only developed pictures of objects and their movement, but also promoted better thinking.

SUMMARY

1. The results of the Comprehensive and Topical Tests indicate that the X groups are superior to the C groups in both the indirect, interpretative outcomes of instruction and in the immediate, concrete and direct outcomes; but the X superiority is much greater in the latter than in the former. The Topical Tests show that the X superiority in descriptive questions is notably greater than the superiority in explanatory questions. In view of the fact that this experiment lasted only twelve weeks, and since sound thinking ultimately depends on concrete experience, these indications are highly favorable to the films.

CHAPTER XI

SUMMARY OF THE INVESTIGATION

Previous Investigations: Weber's Experiment — University of Chicago Experiment — Characteristics of Previous Experiments — The Present Investigation — Initial Comparison of Experimental and Control Groups — Final Comparison of Experimental and Control Groups: Comparative gains of X and C groups — Average scores of X and C groups on Comprehensive Test C3 — Average scores of X and C groups on Topical Tests — Questionnaire answers — The Specific Contribution of the Films — The Place of Films in the Classroom — Problems for Further Research — Summary.

In the previous chapters the detailed results of the present investigation have been set forth. It is the purpose of the present chapter to bring together in a brief form the chief results of this investigation and to show their setting in the general movement for the use of motion picture films in the classroom. For this purpose a very brief reference will be made to the general nature of two previous investigations. Following that will be given a summary of the present investigation. Finally, some closing comments will be added on the function of motion pictures in the classroom and on the general place and value of scientific investigation in this field.

PREVIOUS INVESTIGATIONS

There have been a number of studies in which the effectiveness of motion picture films as a means of instruction has been compared with the effectiveness of other means, such as verbal discussion and the use of pictures, stereographs, slides, and other visual aids. Some of these experiments were carried on with adequate attention to the requirements of experimental technique, while others were

organized in a very loose fashion. We need give no further attention to the review of the studies which do not conform to scientific requirements. They represent the undue enthusiasm of their authors rather than a scientific and impartial interest in the subject. There have, however, been a number of carefully controlled experiments.

Weber's experiment. One type of experiment is represented by the study conducted by Weber. This study is reported in his Doctor's Thesis under the title "Comparative Effectiveness of Some Visual Aids."[1]

The general procedure of Weber's experiment was to compare the effectiveness of a lesson taught by means of an educational motion picture with the effectiveness of an oral lesson covering the same ground. The oral lesson was prepared by translating the subject matter of the film into language. Selected scenes of the film were described, and this description was read to the children in place of seeing the film. Under these circumstances the film was found to be somewhat more effective than the oral translation.

University of Chicago experiment. Other experiments have been made in which the effectiveness of the film is compared with some other method of teaching the same subject matter without attempting to translate the film directly into language. In such experiments the lessons which are compared cover the same area of instruction and aim to teach the same general facts, but the film and the parallel lesson are both organized with reference to the respective requirements of the two forms of instruction.

This type of experiment may be illustrated by the group of studies carried on in the University of Chicago in 1924. This group included thirteen separate experiments. These experiments covered a number of subjects of instruction

[1] *Comparative Effectiveness of Some Visual Aids,* Educational Screen, Inc., Chicago, Illinois.

such as "Nature Study," "Geography," "Hand Work," "High School Science," "Home Economics," "English," "Health," and "Hand Writing." The experiments, taken as a whole, indicate that the motion picture film has a distinct educational value. The effectiveness of the various films which were used differed considerably, however, and these differences were attributed to the variation in the quality of the films themselves, to the differences in pupils' previous experiences and to the fact that motion picture films are better suited to some purposes than to others.[1]

No attempt can be made in this report to give a complete summary of previous studies. A fuller summary is given by Hollis.[2] The examples cited above have been noted in order to introduce the reader to the general characteristics of the earlier studies and to display the contrast between those studies and the present investigation.

Characteristics of previous experiments. It will be clear from the account of the previous studies that they dealt with small units of instruction. In some cases the unit of instruction was confined to a fifteen-minute period; and in no case, so far as the writers know, did the time extend beyond the usual class period. These studies of the film contributions have usually been restricted to its immediate and direct effects. So far as we know, no studies of the cumulative effects of films used over a considerable period of time have been made.

A second limitation of previous studies is that they have dealt with relatively small groups of children. Although the Chicago study included thirteen separate series of ex-

[1] *Visual Education,* A Comparative Study of Motion Pictures and Other Methods of Instruction, edited by Frank N. Freeman. University of Chicago Press, 1924.

[2] A. P. Hollis, *Motion Pictures in Education,* Century Company, New York. 1926.

periments, each one of them dealt with small numbers of children.

In the third place, former investigations have dealt in part with films which were not produced specifically for educational purposes.

In the fourth place, previous studies were usually carried out under somewhat artificial conditions. The lesson was not a part of the usual course of study in the school but was injected as a separate and unrelated unit. Teaching was often done by the experimenter rather than by the usual classroom teacher. There was an element of strangeness which may have seriously influenced the results.

This analysis of the previous studies indicates strongly the need of a more extensive study, which should be more deliberately planned, and which should be carried out under normal classroom conditions. The manner in which the present investigation was planned so as to meet these demands will be described in the next section.

The need of further study was also indicated by the chaotic conditions which at present characterize the use of motion pictures in the schools. These conditions were outlined in a report to the National Education Association made by Charles H. Judd,[1] chairman of the committee to coöperate with the motion picture producers. In Dr. Judd's report a brief outline is given of a survey made by F. D. McClusky of the status of motion pictures in the public schools of the United States. Although some progress has been made in certain localities since 1923, the general indications of McClusky's survey are still valid in 1929.

Since the report of the committee is itself a summary, it will be impossible to give any adequate account of the re-

[1] Charles H. Judd, Chairman, "Report of the Committee to Coöperate with the Motion Picture Producers," *Addresses and Proceedings of the National Education Association*, Washington, 1923, pages 243 to 250.

sults of the survey. A few outstanding facts, however, may be mentioned. It was found that the appropriations for motion pictures by the public schools were surprisingly small. An average of $2800 is given as representing the annual rental of motion pictures in fourteen of the largest centers. Because of the small appropriations the schools depend to a considerable extent on industrial films. While these films are of some service, they can be regarded only as makeshifts, capable of becoming integrated with the regular curriculum only rarely. The organization of motion picture departments varies in different cities, and many difficulties in the way of distribution are encountered. No clear distinction is drawn between classroom films on the one hand, and films whose purpose is entertainment and the broader, more general type of education, on the other. Entertainment films predominate and are commonly shown in the auditorium. There were, however, at the time of the report, between seven thousand and eight thousand projecting machines in the schools.

The report concludes by pointing out the necessity of "experimentation and research, having for its purpose the discovery and development of the best methods for using motion pictures in teaching." In this field a start has been made, but the work has not yet reached the point where the results are getting back to the classroom teacher.

The report of this committee was followed by the appointment by the National Education Association of a committee on visual education, under the chairmanship of Dr. Thomas E. Finegan. This committee made reports to the Association, which were published in the *Proceedings* of 1924 and 1926. In the second of these reports it was announced that the Eastman Kodak Company had decided to embark upon an extensive experiment in the producton of motion pictures to determine the value of films in the regular classroom work

of the schools. It is this experiment which forms the subject of the present report.

THE PRESENT INVESTIGATION

The present investigation was undertaken with the double purpose of determining whether it is desirable for school administrators and teachers to embark upon a more extensive program for the use of motion pictures in the classroom, and of ascertaining whether it would be wise for the Eastman Kodak Company to undertake a large-scale production of classroom films. It is obvious, therefore, that this investigation had to be much more extensive and broader in scope than were the previous studies, and that their limitations and defects had to be avoided.

The present study had the decided advantage of using films which were produced specifically for the investigation. One who is acquainted with the personnel and financial resources which are necessary to produce motion picture films may have some realization of the magnitude of this undertaking. Its magnitude may be further appreciated when it is said that the motion picture films used in this experiment were more elaborately planned and produced than is common. Many so-called educational motion pictures are simply assembled from extant materials. These films were made from scenarios prepared by experienced teachers and in most cases the scenes required were especially photographed. Before the photographs were taken, the scenarios were carefully worked out and criticized, and educational continuities made from them. In planning the pictures, coöperation was secured from committees of teachers in a dozen or so different cities. After the photography was done, much time was taken in editing and assembling the films. In some cases it was necessary for the photographer to return to the location and take additional pictures.

Two series of classroom films were worked out in this fashion for use in the experiment. One series was in Geography and was designed for use in the fourth, fifth, and sixth grades of the elementary school. The other series was in General Science and was designed for use in the junior high school.

The subjects which were represented in these films were selected after a careful survey of the curriculum in these two subjects by the Curriculum Research Committee of Teachers College, Columbia University, under the chairmanship of Professor Herbert Bruner. This survey was based upon the examination of large numbers of courses of study. Subjects were also selected with a view to their adaptability for presentation through motion pictures.

The plan of the experiment required not only a carefully organized series of classroom films, but also a set of Teachers' Guides giving directions for the organization of the instruction in the topics covered by the films. The plan of the experiment required that the instruction should be carried on in a relatively uniform manner. The guides were for the purpose of securing this uniformity. It is recognized that, under ordinary conditions, teachers will have greater freedom in planning and carrying out their instruction than they exercised in this investigation.

In addition to the Teachers' Guides, which were used by the teachers of the classes in which the films were shown, it was found necessary to formulate a series of Study Guides. These Study Guides were prepared to insure that the classes in which the films were not used should cover the same specific area of instruction as the classes in which they were used. These Study Guides were put in the hands of each pupil in the two series of classes. The Study Guides constituted one of the most important elements in the experiment.

As has already been said, each series of films was planned definitely for use in particular school grades and for the teaching of particular topics. Each series was planned to cover ten weeks of instruction. Each school that participated adopted the portion of the course of study laid out by this series of films for the purposes of the experiment.

The magnitude of the experiment can also be judged from the number of school systems and the numbers of teachers and children who took part in it. Twelve of the larger school systems of the country coöperated heartily in the investigation. In all about eleven thousand children were included in the classes which were taught with the aid of the films or which followed the parallel course of study without the films. About two thirds of these were in the elementary school, and one third were in the junior high school. Each of the school systems coöperated whole-heartedly in carrying on the instruction according to the procedure prescribed for the experiment. One or the other of the authors of this report visited each city and went over the plans for the study with great care, except in the case of the two cities on the Pacific Coast. Every detail of instruction and of testing which was necessary to insure uniformity of conditions and comparability of the results was described carefully in these preliminary conferences. Comparative effectiveness of the instruction by means of the classroom films and of the parallel instruction was measured by two series of tests. These two series of tests were worked out more or less separately and constitute independent measures of the effectiveness of the films. Elaborate care was taken in both the organization of the testing and in the scoring and tabulation of the results. The details of the procedure are given in the body of the report.

INITIAL COMPARISON OF THE EXPERIMENTAL AND CONTROL GROUPS

It is an elementary requirement of experimental technique that the Experimental and Control groups of children shall be similar in all those characteristics which may affect their attainments. If such similarity cannot be secured, it is necessary that the differences between the two groups shall be known and allowances made for them in interpreting the results.

A primary requirement of this principle was that children of the two groups should be of the same school grade. This requirement was, with one exception, observed. In this one exception the variation was to the disadvantage of the X group. To secure pupils of the same grade would, under the conditions of the experiment, insure that they would also be of the same average age.

The pupils in the parallel groups (X and C) were drawn from the same general type of neighborhood. This tended to insure similar social and cultural background, a general similarity in nationality or race and language, and, roughly, a similarity in intelligence.

The schools in which the two groups were taught were so selected that they would be similar in general character. With very few exceptions, however, the requirement was laid down that the X and C classes should be in different schools. This was to prevent communication between either teachers or pupils of the parallel groups.

Conditions were planned to prevent, as far as possible, any unnatural competition. The aim was to make the conditions as natural as possible. The control teachers were free to use any method or device of instruction other than the motion picture film.

Besides the general provisions for securing similarity in the parallel groups, intelligence test scores were secured on

all the pupils who took part in the investigation. These scores were tabulated and yielded a comparison between the two groups. It appeared from this comparison that the C groups were superior to the X groups, especially in the classes in General Science. The comparison between the parallel groups was also made by means of the initial scores on a Comprehensive Test on the subject matter to be studied. The C groups were found to be superior also on this test to the extent of ten or twenty per cent of the standard deviation of the scores of both groups. The combined results of the tabulations of the intelligence test scores and of the preliminary achievement test scores showed beyond question that the group which used the films had no initial advantage. On the contrary, they suffered a substantial initial handicap. If any difference between the two groups existed, it was, of course, desirable that it should be in this direction. This fact, however, has to be taken into account in interpreting the final comparisons of the X and C groups.

FINAL COMPARISON OF THE EXPERIMENTAL AND CONTROL GROUPS

Comparative gains of X and C groups. The effectiveness of the instruction with the aid of the films was measured in two ways. In the first place, the gains which were made by the two groups from the beginning to the end of the experiment were compared. This was done by giving the same test to the pupils at the beginning and the end. This test is called Comprehensive Test C2 and is made up of one hundred items of the multiple-choice type. Comparing the *gains* of the X and C groups is one way of making a partial allowance for the difference which existed in their initial achievements.

If we examine the average gains made by the entire group of children in all cities and on all topics taken together, we

find that the X group excelled the C group by a substantial and significant margin. This superiority of the X group was greater in the case of Geography. We may express the difference in standard units by calculating the percentage which the difference is of the standard deviation of the scores of the entire group. This unit of measure has the advantage of comparability. It means the same thing whatever test is used. In the case of the Geography series, the gains of the X group exceeded the gains of the C group by 33 per cent of the standard deviation of all the scores. In the topics on General Science the gains of the X group exceeded those of the C group by 15 per cent of the standard deviation. Stated in another way, it appears that in Geography the superiority of the X group in gains is about 17 per cent of the mean gain of both groups, and in General Science the X superiority is about 11 per cent of the mean gain of both groups. Or stated in still another way; it appears that in Geography 72 per cent of the X group gained more than the average gain of the C group, and that only 29 per cent of the C group gained as much as, or more than, the average gain of the X group; and in General Science 60 per cent of the X group gained more than the average gain of the C group, and only 38 per cent of the C group gained as much as, or more than, the average gain of the X group. These are substantial and reliable differences. The detailed evidence that the differences are reliable is presented in the body of the report.

This general comparison may be supplemented by a more detailed examination of the gains made in the several cities and in the individual topics of instruction. We may first examine the results in the several cities. In the topics on Geography the X group made greater gains than the C group in all but one city. In this one city the difference in favor of the C group was so small as to be negligible. It

may be said, then, that it is the exception which proves the rule. An explanation for this exception is offered in Chapter VII. In General Science, where the difference between the two groups is not so great, there are four cities out of twelve in which the gain of the C group is greater than that of the X group. In one of these cities, however, the difference is negligible and in another the total number of children on which the difference is based is only fifty-seven. Again, the explanation of the two remaining exceptions is attempted in Chapter VII. It would be surprising if the results were entirely uniform. The conditions in different cities and in different schools vary. The abilities, attitudes, and interests of teachers, the previous methods of teaching and the methods used in the parallel group, all affect the results. This variation indicates the necessity of including in such an investigation a number of cities and several classes in each city.

We may also make comparisons according to the various topics of instruction. There were ten topics in each of the series. We might expect some variation in the effectiveness of the different films. Such variation was, in fact, found to exist. In the Geography series, however, all but two of the topics yielded a superior score for the X group. In the topics on General Science there were four topics in which the C group excelled the X group by a significant margin. There was one other in which the difference was negligible. This leaves five films in which the X group was notably superior, and one in which the two groups were approximately equal. Considering the initial disadvantage of the X group, which may have affected not only the final scores but also the gains, this result indicates that in the majority of the topics in General Science, as well as in Geography, instruction with the aid of the films proved to be superior to instruction without the films. It remains for further

investigation to determine why some films were superior to others. Such investigation should furnish a helpful guide for the future production of films.

Average scores of X and C groups on Test C3. On the remaining tests the comparison can be made only on the final scores since these tests were not given at the outset of the experiment. Two such comparisons can be made. The first is based upon the results of the Final Comprehensive Tests (C3). It will be remembered that these tests were so constructed as to measure particularly the more direct and concrete aspects of the pupil's experience. The C2 Tests, on the other hand, measured the more abstract and indirect phases of that experience. In the interpretation of these final tests it is further to be remembered that the X group in General Science suffered a handicap due to its initial inferiority in intelligence and in knowledge of the subject.

As measured by the C3 Tests the X group was superior to the C group on the average in every city in both Geography and General Science. The superiority in all cities taken together in the topics in Geography was 85 per cent of the standard deviation of the scores of both X and C groups together. In General Science the average superiority of the X group was 78 per cent of the standard deviation. Another way of expressing the difference is to say that 80 per cent of the pupils in the X group excel the average of the C group in Geography, and that 75 per cent of the X group excel the average of the C group in General Science. This indicates that when the tests measure the knowledge which the pupils have obtained of the concrete phases of the topics, the group which saw the film was decidedly superior in attainment even when it suffered an initial handicap.

Average scores of X and C groups on Topical Tests. A similar comparison was made by means of a second series of tests which have been called Topical Tests. As contrasted

with the tests previously mentioned, these tests are of the essay type. They require the pupils to give the answer to specific questions either in the form of a very brief written composition or by means of a map or a diagram. The questions on this test were so formulated as to require very specific and definite responses. They could be scored in terms of points. The tests were printed upon blanks in which a space was left for each answer proportioned to the scope of the question.

According to the results of these tests the X group excelled the C group in Geography to the extent of 29 per cent of the standard deviation. In General Science the X group was superior to the extent of 23 per cent of the standard deviation. This means that 61 per cent of the pupils in Geography and 59 per cent in General Science excelled the average of the C group. Both of these measures are statistically significant and represent marked superiority. The superiority in General Science would have been still greater if the two groups had been equal in ability at the outset. When the scores are tabulated by cities it appears that in Geography the X group excels the C group in every city. In General Science the X group is superior in nine of the twelve cities. When the scores in Geography are tabulated by topics the X group is superior in nine out of ten. In General Science the X group is superior in six of the ten topics.

Questionnaire answers. The results of the tests were supplemented by a questionnaire which was sent to all teachers of X classes. The purpose of this questionnaire was to ascertain whether the teachers believed that the instruction by the use of the films was more effective than the instruction which they had commonly carried on by the usual methods. These questions went into some detail to discover whether the pupils manifested greater interest and whether they carried on more vigorous and sustained activ-

ity as a consequence of the use of the films. The general tenor of the replies was decidedly favorable to films. When the replies to the questions were tabulated, it appeared that a very large majority of the answers indicated that the films enhanced the interest of the children in their work and prompted them to more energetic activity in supplementing the knowledge which they gained in the classroom by means of outside readings and the collection of illustrative material. The negative replies were so few and so qualified as to strengthen rather than weaken the majority opinion.

THE SPECIFIC CONTRIBUTION OF THE FILMS

It was felt by the experimenters to be important not only to determine the general effectiveness of the classroom films, but also to discover more precisely the nature of their contributions. That is, it was thought desirable to inquire whether the films were more effective in bringing about some outcomes of instruction than others. It may be that the films contribute more to certain aspects of the pupil's experience and relatively less to others. If this is the case a knowledge of the fact will serve to guide the administrator and the teacher in determining what parts of the curriculum should be taught with the aid of films, and it will aid the producers in determining what films should be produced and what the subject matter of these films should be.

Such an analysis can be made by comparing the results of the different tests with each other. It has already been remarked that the Comprehensive Tests (C2) which were given both at the beginning and at the end consisted largely of questions which depended upon a knowledge of more or less abstract facts, or upon the results of thinking. On the negative side, these tests did not depend primarily upon the ability of the pupils to describe the concrete aspect of physical objects. By contrast, Test C3 emphasized the

ability of the pupils to recall concrete objects and processes which were involved in the courses of study. Many of the items of the Topical Tests also were of this concrete character. By comparing the attainments of the X group upon these different tests, then, we may get some answer to our question. We have already seen that the X groups were more decidedly superior on Comprehensive Test C3 and on the Topical Tests than they were on Test C2. In other words, the X groups excelled the C groups in their knowledge of the concrete aspects of the subject more than they did in their knowledge of more abstract facts or in their ability to give explanations and generalizations.

The same difference is manifested when we analyze the individual questions of the Topical Test. These questions can be classified into several groups. The chief groups are three. The first of these consists of questions requiring the pupil to describe some object or action. The second requires the pupil to recall and state some fact. The third requires him to give an explanation or make a comparison. An example of the descriptive question is: Tell how the corn borer is destroyed. An example of a fact question is: In what States is cattle raising an important industry? An example of the explanatory question is: Why is dairying a prominent industry in the State of Wisconsin?

When the comparative attainments of the X and C groups were calculated on the different types of questions a measurable difference was found. In both the Geography topics and the topics in General Science the X group was decidedly superior on the descriptive type of question. On the more abstract type of question, on the other hand, the two groups, as measured by the final scores, were approximately equal. When allowance was made for the initial handicap of the X groups, the X groups were also superior, but their superiority was less than in the other type of question.

This difference in the relative attainment of the X and C groups is of broad significance and leads to a fundamental distinction. The first and most immediate aim of the pupil's education is to make him acquainted with the world about him. He first has to discover the characteristics of the concrete objects of the physical world. This education may be called immediate or direct education. The second and equally important function is to enable the pupil to derive from his direct experience general or abstract ideas and, through reflection and reasoning, to search for and acquire explanatory principles which illuminate his direct or concrete experience. This may be called the indirect phase of education. Both phases are important and neither one is complete without the other.

The foregoing analysis has shown that the motion picture film contributes to both aspects of the child's education. It shows, however, that the film contributes by a much larger amount to the direct than to the indirect aspects. In other words, the film gives the child clear-cut notions of the objects and actions in the world about him. If we ignore certain minor types of motion picture presentation, such as animated diagrams, this comprises the chief educational effect of the film. It is natural, then, that the film should appear to be most effective when tests measure the fullness and clearness of the pupil's concrete ideas.

This is not to say that the ultimate effect of the film is confined to the development of concrete ideas. To draw such a conclusion would be to ignore completely the fundamental relationship between direct experience and thinking. The pupil can think effectively only when he has adequate material with which to think. Superiority in direct experience, then, should increase the effectiveness of the pupil's thinking, and our evidence confirms this expectation. It is on this ground that we find the X group to be superior on the

questions of fact and on the questions demanding explanations as well as on the descriptive questions. The X groups not only keep abreast of the C groups in explanatory and conceptual test items, but, on the whole, show a superiority in this regard. It would be unfortunate to allow the greater superiority in descriptive questions to overshadow the very substantial superiority in explanatory and reasoning types of problems.

The foregoing discussion indicates that the film should devote itself primarily to enabling the pupils to get clear-cut and correct notions of the physical aspect of the world. This is its immediate function. The material which is to be included in the film should be selected with this in view. The ultimate purpose of securing a clear-cut, concrete idea, of course, is to promote exactness and soundness in thinking. The material which is presented to the pupil, then, should be that material which is necessary in order to furnish him with this foundation. The selection of material, of course, and the manner and context in which it is presented, must be determined by the ultimate purpose. This does not mean, however, that an attempt should be made to distort the films from their natural purpose and make them into a means of teaching abstractions directly. Mankind has invented an instrument of abstract thought which is vastly superior to the use of objects, or of pictures of objects. This instrument is language. It is not the business of the films to supplant language. It is their business to give the pupils such direct experience as will give language rich and clear-cut meaning.

THE PLACE OF FILMS IN THE CLASSROOM

The subject of this section has already been anticipated in part. The fundamental principle underlying the use of motion picture films in education was laid down at the con-

clusion of the preceding section. If the motion picture film is to be of maximum service in instruction it should form an integral and regular part of the curriculum and of classroom work. The casual introduction of films into the curriculum without careful planning and careful organization is of comparatively little value. In so far as possible, a classroom film should always be used for some definite and particular purpose. It should be a necessary link in the chain of development of the subject. It should constitute the necessary basis for the understanding, by the pupil, of the phases of the topic which follow, and a clarifying of those that have preceded.

Classroom films, therefore, should have a definite sequence. They should have a pedagogical relationship to each other, to the discussion which takes place in the class, and to the pupil's reading in the textbooks and other reference works. When this is the case, the effect of a series of films is cumulative. That is, the effect of two films is greater when they are used together than the sum of the effects of the two films when they are used separately.

Again, the film should be used in close relationship to explanatory discussion. The film itself will not ordinarily be completely self-explanatory. It will supplant none of the ordinary media of instruction — least of all the teacher. The function of the teacher is to guide the pupil in discovering the explanations of the scenes which are presented in the film and to help him to understand those features which may not be clear. This does not mean that the teacher is always to tell the pupil everything which is not clear to him at first sight. It is frequently better practice to encourage the pupil to puzzle out the explanation of the picture himself. At what point the teacher should tell the pupil has to be determined in each particular case. It is clear, however, that the teacher has a definite function in directing the

pupil's attention toward the salient aspects of the film and in helping him to help himself in interpreting the film.

Such supplementary help as must be given to enable the pupil to understand the film may be provided in various ways. One method, of course, is to give directions and statements of fact in the printed captions of the film. In the present series of films very sparing use was made of sub-titles. This is undoubtedly wise as a general policy. Whether in every individual case the decision to omit a sub-title was correct, demands, of course, further experimental investigation. The other method is for the teacher to supply the necessary guidance to the pupils by verbal comment either before, during, or after the presentation of the film. There is a general prejudice among specialists in visual education against having a teacher talk during the showing of the picture. This prejudice is probably due largely to the fear that the teacher will not give the verbal comments in a skillful manner. However this may be, the whole question opens up a large field of investigation.

While the films should be planned so that they can be used as an integral part of a course of study this does not mean that they can only be used in a given, fixed order or under a given plan of development of the subject. Usefulness of the films will be seriously limited if they demand that all teachers who use them follow a rigidly uniform course of study. The films should be so flexible that they can be incorporated into a variety of different courses. They should not dictate the organization of the course, but should be capable of adaptation to the course. It is probable that ultimately the films will be produced in varying units. It would be strange if all topics could be treated advantageously in units of the same length. Furthermore, it is probable that many film units can advantageously be shorter than the standard fifteen-minute unit. The shorter

units will be more conveniently adaptable to various contexts than the longer ones.

A word should be said concerning the purpose and use of the Teachers' Guides which accompany the films. These guides should be helps to the teacher in organizing the lesson or series of lessons in which the film is used. They should not, however, hamper the teacher or prevent the adaptation of the films to different schemes of organization. The use which different teachers make of the guides will depend upon the training and skill of the individual teacher. Some teachers may follow them in detail whereas others may discard them altogether. The guides are not by any means intended to serve in place of textbooks or reference books. It is hardly necessary to add that neither the films nor the guides, nor both taken together, can for a moment be thought of as displacing the teacher.

PROBLEMS FOR FURTHER RESEARCH

Certain problems demanding further research have already been mentioned. The field for research in classroom films is almost limitless, and we can do little more than suggest some of the more insistent problems that are faced by the makers and users of classroom films. Two classes of problems will be mentioned. There is, first, a large group of semi-technical and pedagogical problems which should receive the early attention of research scholars:

1. The pedagogical structure of a film or of a series of films; and the organization of the film into the lesson plans of the course of study and into the classroom exercise.
2. Length, frequency, and character of sub-titles in various types of films for children of various age and grade groups.
3. The place of animated diagrams in various fields of study.

4. Adaptation of film instruction to various age and grade groups.
5. Adaptation of a given film to various courses of study.
6. Combination of slides and other visual media with motion pictures.
7. Repeated showing of the same film and of its parts.
8. Time allotments to various types of films and film sequences.

An important administrative problem is already looming large before many school Superintendents and Principals and deserves immediate attention: the organization, administration, housing and care of the film library of the individual school and of the town- or city-wide school system.

In addition to these problems which are of common interest to most school groups, there are several questions of special significance to certain school interests. Teachers of English have long looked upon the screening of classic stories and novels with interest; the influence of such pictures on the literary interests, tastes, and activities, and upon the speech and writing of children deserves large-scale research. More recently a promising interest has developed in the possible uses of classroom films in the teaching of English composition, narrative, descriptive and expository. The adaptation of classroom films to the needs of special school classes, e.g., classes in institutions for the Deaf and Dumb, raises many special problems of sub-titles, animated diagrams, etc. The use of slow-motion pictures in various training problems, and in scientific research, suggests vast possibilities for interesting and valuable research. The promised early solution of the mechanical and technical problems of sound and color photography will open up a new and unmeasured field for many types of research.

A second class of problems includes a host of general and semi-sociological questions which are of especial interest to the educational philosopher. No attempt can be made here to suggest even a partial list of them. An important group of such questions is concerned with the intimate reactions of the student to the film and its component scenes and units. Analysis of the intellectual, æsthetic, and emotional reactions of classes and of individual students of various types, ages, and backgrounds to specific elements in films and in film sequences will furnish the surest foundation for increasing the educational values, economies, and adaptabilities of classroom films. In such researches the most important desideratum is to keep the experimental and control subjects under observation for a long period of time. The immediate reactions of children are important, but the enduring contributions of the films, and the form in which they ultimately manifest themselves in the conduct, habits, and attitudes of children, constitute the prime interest of the classroom film investigator. Some of the possible remote effects on children of seeing good films in the classroom several times a week should be particularly enticing to those interested in educational and social research. The richer and more concrete foundation for thinking provided by good classroom films throughout the elementary and secondary school years may lead to such sound habits of study and thought on the part of children as to reduce materially the often lamented preoccupation of students throughout the whole educational ladder, from grade school to university, with the empty generalizations and *a priori* verbalisms which now constitute too large a part of their intellectual pabulum and which exercise a too exclusive domination over their habits of thinking. Nor is it too far-fetched to suggest that constant and profitable study over a series of years with good films, which challenge the æsthetic no less than

the intellectual resources of children, may slowly and unostentatiously but surely develop in them such deeply set criteria of merit and good taste as to help solve, in the only way it can be solved, the social problem created by certain types of "amusement" films whose currency is deplored both by anxious parents and by the best elements in the theater film industry itself.

The present investigation has been concerned with the contribution of twenty films to the ordinary outcomes of classroom exercises as these are usually measured, observed, and estimated. We believe that the Eastman teaching film experiment has uncovered only a small part of the film contributions, but that the demonstrated contributions amply justify the extensive use of films of this type in our schools. It seems likely that most of the research in the field of the classroom film that may be undertaken in the next few years will be devoted largely to the more or less immediate classroom products and pedagogical problems created by such films. Such research is much needed, and will make contributions of indispensable value. But the classroom film is, or will be, a social agency whose power will be felt far beyond the walls of the classroom and whose effects will be far too variegated and subtle to be measured or described by the types of tests, examinations, and observations currently used in the classroom. The potential power of the classroom film, as a part of the daily experience of the elementary and secondary school population, is amply indicated by the fact that the entertainment film has left no element in our social or individual life untouched. The theater film, specifically designed to entertain people while within the walls of the theater, has revolutionized our ideas, manners, customs, tastes, and morals, and makes and unmakes overnight the vocabulary of vast sections of our population, and has instituted a gigantic world-wide system

of "adult education" long before the phrase was current in learned circles. The school man may properly inquire first about the immediate classroom contributions of films of this type; but he will err if he bases his judgment solely on the evidence of such contributions. In the classroom film we envisage an agency whose potentialities are easily underestimated. This is our justification for closing our report with these paragraphs on "Problems for Further Research," and for calling attention to the great importance of long-continued research on the remote and enduring contributions of the films, the manifestations of which may be long delayed, or subtly concealed in the general conduct, habits, and tastes of the individual.

APPENDIX I

STUDY GUIDES

EASTMAN CLASSROOM FILMS

The same study guide on each topic was used by the pupils of the X and C groups. The areas of instruction and the tests were confined to the subject matter indicated in these guides which are reprinted here, omitting the minor sub-heads.

Geography Series, Study Guide No. 1

(Reproduced in full on pages 12–16.)

Geography Series, Study Guide No. 2

WISCONSIN DAIRIES

I. General Survey.

a. Be prepared to discuss:

(1) Handling of dairy cows on a small farm.

(2) Handling of large herds of dairy cows.

(3) Preparation of milk for shipment in large quantities.

b. Locate on map the dairying area of Wisconsin and be prepared to discuss location in relation to

(1) Climate

(2) Large bodies of water

(3) Cities

Note — Dairying is one of the large industries of the United States. The 22,000,000 dairy cows produce about 110 gallons of milk a year for each man, woman, and child in the country. Half of this amount goes to the consumer as milk or cream, and the balance is made into butter, cheese, ice cream, and condensed milk products. Four States, Wisconsin, Minnesota, Iowa, and New York, in order named, each have over 1,000,000 dairy cows. Illinois, Pennsylvania, Texas, Ohio, Michigan, and Missouri follow in order with more than 800,000 each. The number of dairy cows corresponds in a general way to the density of population, the greatest being New England, North Atlantic, and Great Lakes areas. Dairying, however, is carried on successfully in every State of the Union. Milk production tends to center about urban areas, while butter and cheese production

has a tendency to center in rural sections. Tank truck and tank car make it possible to ship fresh milk in good condition long distances. Some Wisconsin milk is now being shipped direct to Florida.

c. *Be prepared to report to the class on the topic assigned you from the following:*
   (1) Breeds of dairy cattle and characteristics and uses of each.
   (2) Silos and ensilage.
   (3) Pasteurization of milk and its history.
   (4) Refrigerator cars.
   (5) Milk inspection by city boards of health.

II. Dairying on a Small Farm.

a. *Be prepared to discuss:*
   (1) Attention given to dairy cows when only a few are kept.
   (2) Milking a small herd.
   (3) Straining and cooling milk.
   (4) Collection of milk.
   (5) Summarize reasons why the farmer who keeps only a few cows can afford to devote but a small part of his time and attention to them.

Note — Wisconsin leads the States in the dairy industry, its annual production of milk being about 1/9 of the total production in the United States. Four factors have been of importance in the development of this industry in Wisconsin: (1) the soil, (2) the climate, (3) the large number of Germans and Swiss who settled there, and (4) the growth of cities along the southern end of Lake Michigan. Besides its great output of dairy products Wisconsin has made valuable contributions to the advancement of the dairy industry. Eight out of the nine dairy tests recognized as of great importance throughout America were developed by scientists at Wisconsin Agricultural College.

III. Dairying on a Large Scale.

a. *Be prepared to discuss:*
   (1) Summer and winter feeding and sheltering of dairy cows.
   (2) Differences in care of large dairy herds and small farm herds.

(3) Milking of cows.

(4) Preparing milk for company dairy.

Note — Cows must be fed carefully during both summer and winter if a large amount of milk is desired. Milk is not created by cows, but some of the food they eat is changed into milk and both quantity and quality of milk depend upon the character of the food. Not only must they have an abundance of nourishing food, but it must taste good to them. Fresh grass eaten in large quantities is their best food, but in winter when it is impossible to feed them fresh grass, hay is sprinkled with salty water or molasses water to improve the taste. During the winter succulent food is provided for by ensilage which is usually made from green corn. The stalks and leaves are cut up in the fall and packed tightly into a huge barrel-like air-tight building called a silo, from which it is taken as needed during the winter.

Cows may be milked by hand or by milking machines. Some compressed air machines are so constructed as to milk two cows at once. One man caring for two machines can milk four cows in less time than he could milk one cow by hand. Milking machines are covered, thus keeping milk cleaner than open pails and hands, and there is less possibility for dust to get into the milk. Clean milk is one of the world's best foods, but unclean milk is a dangerous source of disease. In order to produce milk free from disease-causing bacteria, great care must be taken in all the processes of dairying. It begins with the health and cleanliness of the cows, which must be healthy, clean, and in good physical condition in order to produce pure milk. Everything that milk comes near must be clean. This means barnyards, barns, feed, stalls, pails, men, cans, strainers, and all else. All utensils such as pails, cans, and machines must not only be clean but must be sterilized by either hot water or steam.

IV. Preparing Milk in a Company Dairy for the City Market.

a. Be prepared to discuss:

(1) Transportation of milk from dairy farm and unloading it at company dairy.

(2) Pasteurizing and bottling of milk.

(3) Loading railroad cars with milk for shipping.

Note — Speed, temperature, and cleanliness are the three most important factors in the handling of milk. It is said that

a letter mailed in front of the farm house at the same time the milk is picked up by the truck, will be a longer time reaching a person in the city than the milk, that is, transportation of milk is swifter than the mails. Good roads are important in this transportation, for their smoothness prevents churning. After the milk reaches the company dairy it is put through a process called pasteurization to kill disease-producing bacteria. In this process the milk is heated to a temperature of 145° and kept at that temperature for at least thirty minutes. It is then automatically bottled and sealed in sterilized bottles to be shipped in refrigerator cars. Sometimes the cooled milk, instead of being bottled, is run through pipe lines into tank cars which are constructed on much the same principle as a thermos bottle.

V. Reorganization Review.

a. Be prepared to report on topic assigned you.

b. Discuss evidence for the following conclusions:

(1) Large-scale milk production makes possible the use of modern methods which are not only more sanitary, but more profitable.

(2) Cleanliness is an important factor in the handling and marketing of milk.

(3) The perishable nature of milk requires special methods of handling and transportation.

(4) The coöperation of many people is essential in supplying a city with pure milk.

c. Write a brief description of the processes involved in providing a daily supply of pure milk for your tables.

References:

The World Book. (See "Dairying and Wisconsin.")

Washburn, R. M.: *Productive Dairying.* J. B. Lippincott Company.

Compton's Pictured Encyclopedia. (See "Dairying.")

Geography Series, Study Guide No. 3

WHEAT

I. General Survey.

a. Be prepared to discuss:

(1) Preparation of the land for seed.

(2) Sowing the wheat.

(3) Harvesting.

(4) Threshing.
(5) Storing the wheat.
(6) Wheat growing in the United States.

b. Be prepared to report on topic assigned your group from the following list:

(1) Pioneer wheat growing in the United States.
(2) The history of the reaper and binder.
(3) Life on a small farm where winter wheat is one of the several crops grown.
(4) Description of a large storage elevator for wheat.
(5) Description of a large farm in the Dakotas where spring wheat is the main crop grown.

II. Early Wheat Growing.

a. Be prepared to discuss:

(1) Plowing in the early days.
(2) Harvesting in the early days.
(3) Threshing in the early days.
(4) How hand labor affected early wheat growing.

Note — It is estimated that one man could cut and bind an acre of wheat by hand by the early method of cradling, during the short harvesting season in the winter wheat section. Wheat ripens rapidly during the hot season and when too ripe the wheat grains fall out of the heads with very little handling. The cutting season in this region is often limited to a period of one week.

Winter wheat is sown in the fall and gets a growth of several inches before winter sets in. Under favorable conditions the growth is resumed early in the spring and the wheat matures early in July. Spring wheat is sown in the spring and does all of its growing in one season. It matures later than winter wheat. Spring rains make it impossible for wheat to be sown early enough to mature before the fall rains in the winter wheat belt set in. Spring wheat is sown in an area of light rainfall and extreme summer heat. The farmer can get on his land as soon as the ground is thawed out enough to sow. It requires about five months for wheat to mature. Three months of this growing season the wheat requires no attention at all.

III. Improved Farm Machinery and Wheat Production.

a. Be prepared to discuss:

(1) How changed methods of plowing affected wheat farming.

(2) Sowing wheat with the drill.
(3) How harvesting machines have influenced wheat growing.
(4) Modern threshing operations.
(5) How the tractor has helped the wheat farmer.

NOTE — Wheat is the staple cereal of the temperate climes of the western world. Each person requires about five bushels per year of which the United States produces about one fifth. Wheat will thrive with a minimum of moisture and will grow in dry areas. Dry farming has stimulated wheat growing in this country. Since wheat can send its roots to a depth of five feet in search of moisture dry farming aims to conserve the moisture that is in the ground by keeping a thin layer of soil porous. The advantage of the United States as a wheat growing section is accounted for on the basis of the following physical facts: very great summer heat, humidity during the spring resulting from melting snow, glacial clays, and the human factor of maximum perfection of labor saving machinery. Spring wheat grown under the conditions named has greater food content, is harder and hardier than winter wheat which is usually grown under conditions of maximum moisture. Winter wheat is usually grown by a diversified crop farmer, that is, wheat is only one of several crops grown. His acreage is usually small and his harvesting season is short. The winter wheat farmer is usually not dependent upon his wheat fields alone, therefore, he is the conditioning factor in the production of his farm. His machinery is limited to his own needs except his threshing operations which are of a coöperative nature.

In the winter wheat area the farmer raises much cattle. He has abundant need for straw for bedding and for food. Straw becomes a valuable by-product of his wheat raising and is carefully stacked. Because the winter wheat farmer raises other crops and cattle and because of the nature of the climate his wheat is generally stored in his large barns until the summer rush is over and then it is threshed and the grain is also stored in his own bins until a favorable opportunity for selling presents itself. In this section each farmer disposes of his own crop without much regard for what other farmers are doing.

IV. THE MODERN ELEVATOR AS ADAPTED TO THE NEEDS OF LARGE-SCALE PRODUCTION.

a. Be prepared to discuss:

(1) How and why the farmer uses a local elevator.

(2) The large storage elevator.
(3) Why wheat is stored in elevators.
(4) The location of central elevators.
(5) Construction of elevators.

V. Reorganization Review.

a. Be prepared to give assigned reports.

b. Summarize the evidence that the use of labor saving machinery has greatly increased farm production:

(1) Comparison of horse-drawn machinery with hand methods.
(2) Comparison of motor-drawn machinery with horse-drawn machinery.
(3) Advantages and limitations of machine methods.

References:

Crissey: *The Story of Foods.* Rand, McNally Company.
Allen: *United States.* Ginn and Company.
Carpenter: *The Carpenter Readers.* American Book Company.
Chamberlain: *The Chamberlain Readers.* The Macmillan Company.
Adams: *Elementary Commercial Geography.* D. Appleton and Company.
Pitkin and Hughes: *Seeing America — Farm and Field.* The Macmillan Company.
Basic Texts in Geography.

Geography Series, Study Guide No. 4

FROM WHEAT TO BREAD

I. General Survey.

a. Be prepared to discuss:

(1) The arrival of the wheat at the flour mill.
(2) How wheat is made into flour.
(3) How dough is made at the bakery.
(4) How dough is made into bread.
(5) How bread is prepared for delivery.

b. Be prepared to report on the topic assigned your group from the following list:

(1) Primitive flour making and bread baking with a description of the oven.

(2) The old-time grist mill.
(3) Description of the modern flour mill.
(4) Description of a modern bakery.
(5) How bread is delivered.

II. How Flour is Made.

a. Be prepared to discuss:

(1) Flour making in the old grist mill.

Note — The mill wheel of earlier days was the pioneer method of using the power of water to run machinery. The wheels were constructed with paddles or buckets against which the water would flow forcing the wheel to revolve. A shaft running from the wheel to the machine to be driven would put the machine into operation whenever the water was allowed to run through the control gate. When the wheel was constructed to permit the water to flow over the wheel it was called an overshot wheel, when the water flowed under the wheel it was called an undershot wheel. In general, the principle is followed in the modern turbine wheel for generating water power.

(2) How and why the grist mill gave way to the modern flour mill.
(3) The location and construction of a modern flour mill.

Note — The flour mill is a many-storied building. There is a story or floor for each process. Usually there are from seven to nine processes, therefore, the modern mill has from seven to nine stories or floors. The wheat is received and stored in bins on the top floor.

(4) How the wheat is received and prepared for grinding.
(5) How the conveyor belt saves labor.
(6) Grinding wheat.
(7) Sifting flour.
(8) The by-products of the flour mill.
(9) Packing and shipping flour.
(10) Automatic machinery.

Note — When wheat arrives at the mill it comes in bulk direct from the central elevator. It has in it foreign matter such as weed seeds, small stones, dirt and dust. In it are also found nails and iron materials lost from former processes.

These particles would ruin the rollers and must be removed. Sometimes the wheat must be washed but always it is put through blowers to remove the foreign substances. Iron materials are sometimes caught on magnets, and sometimes the wheat is agitated in such a way that the greater weight of these substances causes them to sink while the wheat is carried off on top.

It is the nature of some grades of wheat to be harder than others. The outside portion of a kernel of wheat is harder than the inside. By the different processes of grinding the harder portions of wheat are ground separately, and in this way several grades of flour are produced. Flour taken from the outside part of the kernel is a superior quality and costs considerably more than the inside of the kernel.

Bran is the outside shell which protects the wheat grain. In white flour the bran is carefully removed, mostly in the first grinding. Sometimes the wheat is moistened or steamed in order that the bran may be removed more easily. Bran is supposed to have merit as a regulator of the human system and is used as a food for man. The greater part of the bran is used as food for cattle. The germ of the wheat is not used in flour making, generally. It is often used as a food for cattle. The germ is the sprout.

III. Baking Bread in a Modern Bakery.

a. Be prepared to discuss:

(1) The making of dough.
(2) The place of shortening, milk, and yeast in the "bread batch."
(3) Kneading the dough.
(4) Setting the dough to rise.
(5) Making the loaf.
(6) Pre-baking processes of the formed loaf.
(7) Baking the bread.
(8) Preparing bread for delivery.
(9) Why the baker must have his own delivery system.

b. Advantages of automatic machinery.

(1) Influence upon production.
(2) How automatic machinery affects uniformity.
(3) Influence upon labor.
(4) How automatic machinery affects costs.

IV. Reorganization Review.

a. Be prepared to report on the topic assigned your group.

b. Explain how modern bread supply is made possible by specialized machinery.

(1) How machinery makes quantity production possible.

(2) How machinery makes production of uniform quality possible.

c. Make a design to show how wheat passes through the several stages of grinding at the flour mill. Letter diagram with titles as follows:

(1) The cleaning room.

(2) The rollers.

(3) The conveyor belt.

d. Make a list of machines used in baking, in order of their use.

e. Discuss relation between increased production of bakery bread and conditions of modern home life.

f. Explain why flour mills are centrally located while bakeries are widely scattered.

g. Discuss conditions that affect delivery of bread.

References:

Chamberlain: *How We are Fed.* The Macmillan Company.
Carpenter: *How the World is Fed.* American Book Company.
National Geographic Magazine, vols. 39, 42, 45, 49, 50.

Geography Series, Study Guide No. 5

CATTLE

I. General Survey.

a. Be prepared to discuss:

(1) Appearance of western range.

(2) How cattle are handled on the range.

(3) Winter feed on a cattle ranch.

(4) Shipping cattle to market.

(5) A rodeo.

b. Trace on map the extent of Great Plains.

c. Be prepared to report on topic assigned you from the following list:

(1) Life in summer on a large cattle ranch.

(2) The round-up and its purposes.

(3) How range cattle are cared for in winter.

(4) The rodeo.

NOTE — The region between the Rocky Mountains and east to the tier of States from Texas to North Dakota is an extensive plain area covered with a scant but succulent bunch grass. During the last half of the nineteenth century settlers occupied this land and developed the vast cattle and sheep ranches. The cattle of many ranchers mingle in common herds over the open ranges, and the only way they are known apart is by the brand which assumes a variety of forms — stars, circles, or letters. In early days when there was enough pasture the cattle remained on the range all winter. To-day, they have to be fed at least in part with hay. Cattle are driven to shipping stations, corralled beside the railroad tracks, and driven up inclined planes into cattle cars for shipment to packing centers. The cowboy lives largely outdoors, and the chuck wagon is a familiar sight to him. The principal local event of the season is the rodeo, when he can display his skill and prowess before a cheering crowd. There are two round-ups a year, and one of the purposes is to select cattle for the market. Alfalfa yields better than any other form of hay.

II. HANDLING RANGE CATTLE.

a. Be prepared to discuss:

(1) Size of ranch and number of cattle on it.
(2) How cattle are rounded up and why.
(3) Corrals and how they are used.
(4) How cowboys live and work.
(5) How cattle are dipped.

NOTE — The largest ranch in Texas not long ago was ten miles wide and two hundred miles long. Ten to twenty sections (640 acres each) of land is not unusual in the West. The number of cattle varies from a few hundred to several thousand. Ten thousand were not uncommon a generation ago. Every spring and fall the calves are singled out and branded. Their ownership is determined by that of the mother cow or by lot in proportion to the number of cattle the owner has in the whole herd. Corrals are yards in which livestock are kept closely herded together. For horses a few ropes held up by posts may suffice, but more often the corral is built of posts and refuse lumber of all kinds and shapes. There are also regular board fences. The chuck wagon accompanies the boys to the range if it is far away. It carries provisions, a camp stove, and other equipment. There is also tent material to protect the boys from inclement weather. Herefords are heavy beef cattle and have almost entirely displaced the lanky Longhorns of Texas,

which came originally from Spain. Cattle are dipped in vats filled with disinfectant to destroy a tick which causes cattle fever. This fever spreads rapidly and may ruin whole herds if not checked.

III. Alfalfa for Range Cattle.

a. Be prepared to discuss:

(1) Alfalfa as a hay crop, and how it is harvested on a ranch.

(2) The use of horses and machines in harvesting alfalfa on a ranch.

(3) The shipping of cattle to packing centers.

Note — Alfalfa is cut with a mower and gathered in windrows with a rake. The windrows are then pushed into large piles with a bullrake. All three are operated by horsepower, the last being operated so that the horses walk behind it. The hay from the bullrake is pushed upon another rake which is then hoisted upon the growing stack. Alfalfa is a favorite crop in semi-arid regions. It is a clover hay; its roots store fertility in the soil; it can be cut several times a year; it yields well each time; and it cures well.

Cattle are driven to the railway station and into a specially built stockyard. There is a scale and an inclined plane runway. The stockcar door is set opposite the runway. In the cattle car the animals are headed alternately in opposite directions. In this way the horns will not become entangled; the cattle can also be better fed and watered from the troughs that line the car on each side. On a long trip, cattle are usually unloaded after twenty-eight hours so as to give them a rest from the cramped position, and then reloaded for the balance of the trip. When cattle are four years old they are ready for the market, unless they are sold quite young. They are also sold as yearlings. If cattle of the right age are not fat enough for market, they may be shipped to farms in the Corn Belt where they are fattened. Older cattle are thus kept for about three months and calves as long as six months and then shipped to one of the packing centers.

IV. The Rodeo.

a. Be prepared to discuss:

(1) How a rodeo is staged.

(2) How the events of a rodeo show the work of a cowboy.

NOTE — The arena looks much like a baseball or football field. There is a grandstand and a "bull pen." This latter is a corral or stockade in which the wild animals are kept. These are usually bucking bronchos and energetic steers. In addition to riding bronchos and steers the cowboys bulldog steers, lasso ponies, and do other stunts with the lariat. In a way the rodeo resembles the tournament of the ancient knights; and it appeals to the popular imagination for similar reasons. The events are often quite thrilling. The cowboy also has his moments of relaxation about the ranch-house and around a campfire at night. The outdoors is his home.

V. REORGANIZATION REVIEW.

a. *Have assigned reports ready for discussion.*
b. *Describe briefly the conditions which led to the development of the cattle industry on the Great Plains.*
c. *State ways in which Western ranch life is like the life of the American pioneer.*
d. *Explain why the herding of cattle on open ranges is practiced less to-day than it was a few years ago.*
e. *Write, in ten sentences, a comparison between Western ranch life and the life of the American pioneer.*

References:

Lomax, John A.: *Cowboy Songs, and other Frontier Ballads.* Sturgis and Walton Company, 1916, New York. 427 pp.

Rollins, Philip A.: *The Cowboy; His Characteristics, His Equipment, and His Part in the Development of the West.* Charles Scribner's Sons, 1922, New York. 268 pp.

Bureau of Animal Industry: *The Story of the Cattle Fever Tick.* Washington, Government Printing Office, 1922. 31 pp.

Black, Wm. Henry: *Fattening Steers in the Corn Belt.* United States Department of Agriculture, Farmers' Bulletin No. 1382. 20 pp.

Beef Production in the Corn Belt. United States Department of Agriculture, Farmers' Bulletin No. 1218. 34 pp.

Jardine, James T.: *Range and Cattle Management During Drought.* United States Department of Agriculture, Bulletin No. 1031, 1922.

Morse, Elisha Wilson: *The Ancestry of Domesticated Cattle.* Bureau of Animal Industry Report, 1910. 187–239 pp.

Parr, Virgil Verser: *Beef-Cattle Production in the Range Area.*

United States Department of Agriculture, Farmers' Bulletin No. 1395. 46 pp.

Geography Series, Study Guide No. 6

CORN GROWING

I. General Survey.

a. Be prepared to discuss:

(1) How seed corn is selected and tested.
(2) How the soil is prepared for planting corn.
(3) How growing corn is cultivated.
(4) How corn is harvested.
(5) How corn is used.

b. Trace on a map the corn producing area of the United States.

c. Be prepared to report on the topic assigned your group from the following list:

(1) The corn plant, how it grows and how its ears are formed.
(2) Selecting and testing seed corn.
(3) Rotation of crops in the corn belt.
(4) Pioneer corn growing.
(5) Corn clubs.

Note — In most of the countries of the world wheat and other small grains are known as corn. The corn we know is called maize. The first knowledge Europe had of the corn plant was from explorers in the Americas who found the Indians growing it. To this day a field of growing corn is as rare a sight to the people of northern Europe as a banana plantation is to most of the people of the United States.

Four fifths of the corn in the world is grown in the warm and fertile prairie belt of the United States lying between the wheat growing and the cotton growing belts. The climate and the soil there are highly favorable to corn growing. Most of the corn grown is used as feed for fattening livestock. In this way its value is concentrated in meat products and goes to the market on four legs. Indians and pioneers recognized the value of corn for human food and many corn products factories have been established in recent years to meet the demand for corn foods.

The corn plant, with its tall growth and broad leaves, requires more room for air and sunlight than wheat. It is planted far

enough apart to permit a cultivator to pass between them to destroy weed growth and to loosen up the soil. The loose soil acts as a blanket to reduce the loss of water through evaporation.

II. The Growing of Corn.

a. Be prepared to discuss:

(1) The appearance of the corn plant.
(2) How seed corn is selected.
(3) How seed corn is tested.
(4) How soil is prepared for corn planting.
(5) How corn is planted.
(6) How corn is cultivated.
(7) The rotation of crops.

b. Summarize evidence that successful corn growing requires special knowledge.

Note — The corn tassel at the top of the corn plant bears a yellow pollen which is distributed by the wind. When this pollen falls on the fine threads, called corn silk, which grow out from the head of flowers that will later develop into ears of corn, the flowers are fertilized and the grains of corn grow. Sometimes a flower gets no pollen and no grain grows from it. There are many kinds of corn adapted to various growing conditions. Since pollen is distributed by the wind the same ear may have grains on it with different cross breedings. Ears are selected for seed corn that have closely packed, regularly arranged, and fully developed grains on them. Usually the ears should have grains all the same color, as this indicates a pure and uniform breed. If the ear is not well rounded and grains well developed at the end of the cob, it is not selected for seed as it indicates a probable lack of vitality in the grains. After selecting ears for seed corn, a few grains from the ears are tested to make sure they will sprout.

Before planting, the ground is well broken up to enable the sprouting grain to establish connection with the soil quickly. The pioneer planted corn laboriously, dropping it by hand and covering each hill by means of a hoe. The modern corn planter drops the same number of grains in each hill, spaces the hills, and covers the corn.

Corn grows luxuriantly and takes a large amount of plant food from the soil. For that reason, good corn crops cannot be grown in the same field year after year. Deep plowing brings fresh soil to the surface, but a rotation of crops is the most effective way of conserving soil fertility. In the scheme of rotation a clover crop restores nitrates to the soil.

III. Harvesting Corn.

a. Be prepared to discuss:

(1) How corn is prepared for ensilage.
(2) How ripe corn is cut and shocked.
(3) How the corn borer damages corn.
(4) How the farmer fights the corn borer.
(5) How corn is husked.
(6) How a husking contest is conducted.

Note — In regions, with cold winters, where fodder is needed for livestock, green corn is cut, chopped, and stored in a silo. Usually corn is allowed to ripen in the field. Stalk and leaves turn yellow, and the heavy ears, covered with husks, hang down. Harvesting machines that cut the corn, husk the ears, deliver them to a wagon, and throw the fodder in piles for shocking, are sometimes used on a large farm. More generally the corn is husked from the fields or from shocks by hand. There is often much rivalry shown at corn husking time, and contests are held to determine the champion husker of the neighborhood and even of a whole State. In earlier days the neighbors got together for a corn husking. At night a husking bee with games and dancing was held.

The corn borer does serious damage to the corn plant. In the fall the eggs are laid in the stalk where the grub matures. It feeds on the leaves of the plant and whole fields may be ruined by its ravages. If the stalks are cut close to the ground or the cut field burned over, the home of the borer is destroyed and no grubs can develop to destroy the next year's crop.

IV. The Uses of Corn.

a. Be prepared to discuss:

(1) How corn is shelled.
(2) How corn is unloaded at the corn products factory.
(3) How corn flakes are made.
(4) How corn starch is made.
(5) The feeding of livestock.

V. Reorganization Review.

a. Be prepared to give assigned reports.

b. Discuss reasons for the fact that the United States is the outstanding corn producing country of the world, bringing out the following points:

(1) Value of corn crop of the United States.

(2) How the appearance of the corn plant indicates that it requires a great deal of heat and moisture.
(3) How the prairie lands of the corn belt are adapted to corn growing.
(4) How the growing demand for meat has stimulated corn growing.
(5) Why corn products factories have been established in recent years.

c. Write a short account of the steps taken in corn growing.

References:

Tappan: *The Farmer and His Friends*, chap. v. Houghton Mifflin Company.

Bulletins of the United States Department of Agriculture on *Corn Growing* and on the *Corn Borer*.

Geography Series, Study Guide No. 7

COTTON GROWING

I. General Survey.

a. Be prepared to discuss:
(1) Planting cotton seeds.
(2) Chopping and cultivating cotton.
(3) How the boll weevil is held in check.
(4) Picking cotton.
(5) Ginning cotton.
(6) Baling cotton.

b. Locate on a map the cotton growing areas of the world.

Note — The long season of continuous warm weather, thirty-five degrees north and south of the equator, establishes this area as the location for cotton growing.

The fibers of the sea island cotton are from one and three quarters to two and one half inches long. This is called long staple cotton. Strong warp yarns are made from this cotton. This is used in the finest lawns, muslins, and spool cotton. The upland or short staple cotton is from three quarters to one and a quarter inches long. This is fairly strong and is used for making ginghams, calicos, sheetings, and other coarse cotton material.

Cotton burns easily on account of the natural oil and cellulose in the fibers. It soils easily on account of the short fibers. It

does not absorb water readily and dries slowly because of the vegetable oil and gum in the fiber. It crushes easily because of the vegetable fiber. It shrinks because water removes the finish which has held the stretched fiber in place. It is a non-conductor of heat and therefore good for summer underwear. Laundering does not injure the fibers.

The blossom resembles a hollyhock and lasts about one day. The color changes from yellow in the morning, white at noon, to pink in the evening. Then the withered blossom drops off.

The enemies of the cotton plant are: a wet season, an early frost, the boll weevil, boll borer, cut worm, grasshoppers, and numerous plant diseases.

c. *Prepare a report on topic assigned you from the following list:*

(1) Insect enemies of cotton, and how they are controlled.
(2) Cotton picking machines.
(3) The invention of the cotton gin.
(4) The uses of cotton and cotton seed.

II. THE GROWING OF COTTON.

a. *Be prepared to discuss:*

(1) Preparing the soil.
(2) Planting the seeds.
(3) Chopping the plants.
(4) Cultivating cotton.
(5) The boll weevil.

b. *Compare labor expended in raising cotton with that used in raising wheat.*

III. PICKING COTTON AND PREPARING IT FOR MARKET.

a. *Be prepared to discuss:*

(1) The appearance of a field of ripe cotton.
(2) How cotton is picked.
(3) Weighing cotton.
(4) Ginning cotton.
(5) Baling cotton.
(6) Loading cotton on boats.

b. *Summarize reasons for thinking that picking cotton and preparing it for market require a large amount of labor.*

NOTE — The fastest picker is one who can remove all the cotton from a boll with one grasp. He picks with both hands

from the plants on each side of the row. A good picker can pick from two hundred to four hundred pounds of cotton a day. The pay ranges from sixty to one hundred cents for each one hundred pounds of cotton picked.

The quality of the cotton depends on these properties of the fibers: fineness or coarseness, length and breaking strength. The grade is lowered by dead or unripe fibers or damaged by insects or frosts.

Cotton is the great crop of the South. It is the chief and often almost the only source of income to a large proportion of the farmers in the Southern States. It is so important that low prices or any other factor which greatly reduces the profitableness of the crop greatly disturbs the economic life of the Southern States. When the cotton crop is good and brings good prices the South is prosperous.

There is a division of labor between the States of the North and those of the South by which the North depends upon the South for cotton clothing or the raw materials out of which to manufacture the clothing and for products of the cotton seed, and the South in turn buys many of the products of the farms of the North. It follows, therefore, that when the South is prosperous it furnishes a good market for corn, flour, meat, and dairy products, and that a prosperous North makes a good demand for cotton and cotton products.

Such a large part of the cotton crop is marketed abroad that the prosperity of the South also depends to a considerable extent upon the conditions of the foreign market for cotton.

IV. Reorganization Review.

a. Give assigned reports.

b. Discuss:

(1) Why cotton growing requires so much cheap labor.

(2) Why cotton is grown so extensively in the Southern States.

(3) How a failure of the cotton crop affects the prosperity of the South.

(4) How an unusually large crop of cotton affects the prosperity of the South.

(5) How the Northern States are affected by the cotton crop in the South.

(6) How prosperity in England affects the price of cotton in the South.

c. Describe, in ten written sentences, how the cotton crop affects the prosperity of the South.

References:

Carpenter: *How the World is Clothed.* American Book Company.
Chamberlain: *How We are Clothed.* The Macmillan Company.
Bigwood, G.: *Cotton.* Henry Holt and Company, pages 1–35.
Thompson, E. B.: *The Cotton and Linen Departments.*
Crabtree, J. N.: *The Cotton Industry.* D. Van Nostrand Company, New York, pages 1–31.
Darby, W. D.: *Cotton, The Universal Fiber.* Federal Printing Company, New York, pages 1–27.
The Cotton Situation, *Yearbook of the United States Department of Agriculture,* 1921, pages 323–403.

Geography Series, Study Guide No. 8

IRRIGATION

I. General Survey.

a. Be prepared to discuss:

(1) Appearance of arid lands.
(2) Securing water for irrigation purposes.
(3) Distribution of water to farms.
(4) Effect of irrigation on crops.

b. On a map of the United States locate the Salt River, the Imperial Valley, and San Diego.

c. Prepare to report on a topic assigned from the following list:

(1) The Salt River project.
(2) The Imperial Valley project.
(3) Irrigation in the San Diego district.
(4) Any other large irrigation project.
(5) Methods of irrigating crops.

Note — Abundant materials for these reports may be secured from back numbers of the National Geographic Magazine and publications of the United States Reclamation Service. Where information is available, discussion of the project may include any of the following: financing and construction of irrigation systems; reasons for methods of irrigation used; types of farms, homes, and people; kinds of crops raised and cash return on each per acre; effect on community life including roads, schools, cooperative marketing.

II. Storage Dams.

a. Be prepared to discuss:

(1) How cactus and sagebrush indicate arid land.

(2) Effect of water on arid land.
(3) Irrigation projects of mission priests in California.
(4) Storage dams.
(5) Location of storage dam.
(6) The Roosevelt Dam as compared with the irrigation project of the mission priests.

NOTE — Evaporation leaves dissolved materials essential for plant foods at the surface, and the scanty run-off of water does not carry them away. If evaporation is excessive, however, so much dissolved materials may be left at the surface that plants cannot grow in it.

A dam, to store up a constant supply of water from a stream whose flow is irregular, is usually built across a narrow gorge back of which lies a valley large enough to serve as a reservoir. The Roosevelt Reservoir occupies a part of the Salt River Canyon just below the mouth of Tonto Creek. It is now an artificial lake with an area of about twenty-six square miles, and a capacity of 1,635,000 acre-feet of water. (An acre-foot is the amount of water required to cover an acre of ground a foot in depth, and an acre of ground is equal to a city block of 300 feet by 145 feet.) The dam is 280 feet high and supplies water for over 200,000 acres, and water power for the generation of electricity. It was begun in 1905 and completed in 1911, at a cost of $3,923,250.

III. DIVERSION DAMS.

a. Be prepared to discuss:

(1) Sources of water in the arid Southwest.
(2) Why it is not necessary to throw a storage dam across the Colorado River in its lower course.
(3) The diversion dam for the Imperial Valley project.
(4) Getting the water to the farms.

NOTE — Moisture-laden winds from the Pacific are cooled as they rise to pass over the Sierra Nevada Ranges and the moisture falls as rain or snow. The arid regions of the Southwest lie on the northern edge of the tropical belt of calms and large portions of them are cut off from the westerly rain-bearing winds by the coast ranges. The fall of rain and snow in the mountains is heavy in winter, and flooded streams fed by mountain water flow across the arid lands. In the summer the rainfall is slight in the mountains, and the few streams that find their way across the arid lands lose so much water by evaporation and

seepage that they are greatly reduced in size and many entirely disappear. The Colorado River drains such a large area that it carries a generous supply of water throughout the year. A low drainage divide separates the Colorado from the Imperial Valley, which lies at a lower level than the river. A canal has been cut from the river to the valley; at Rockwood Heading a diversion dam has been built across the canal where it taps the river. Were the water of the Colorado permitted to run freely through the canal, an inland sea would soon cover the Imperial Valley. The dam across the canal is provided with gates through which water can be let into the valley when needed for irrigation.

Water from the main canal is let into a system of division canals. Side ditches carry the water from division canals to farms along the way. Where side ditches branch off from the division canals, weirs are located to measure the amount of water drawn off for use. Water is measured in gallons, cubic feet, and acre-feet.

IV. Farm Crops under Irrigation.

a. Be prepared to discuss:

(1) Supply of water for each farm.
(2) Why alfalfa is a common field crop in irrigated areas.
(3) Field grain as an irrigation crop.
(4) Other crops grown on irrigated lands.

Note — Alfalfa sends deep roots into the soil in search of water. It is a hardy plant, produces abundantly, may be cut several times a year, and the bacteria on its roots fix nitrates in the soil. In arid regions it is safe to permit field grains to ripen on the stem and they may be harvested with combines which cut and thresh them from the field. A melon is a plant device, developed by nature, for storing up water which provides for the sprouting of its seeds during a dry period. The cost of irrigation water makes it desirable to grow crops that are adjusted to arid conditions either by a deep root system, by a capacity to store water, or by a relatively short growing period.

V. Pumps and Flumes.

a. Be prepared to discuss:

(1) Location of storage dams for irrigation in the neighborhood of San Diego.
(2) Distribution of reservoirs in San Diego district.

(3) Construction and uses of flumes and tunnels.
(4) Methods of getting water onto fields.
(5) Use of pumps in irrigation.
(6) Kinds of crops grown in San Diego district.

VI. Reorganization Review.

a. Report on assigned topics.

b. Review briefly the conditions which determine whether storage dams, diversion dams, or pumps shall be used to supply water for irrigation purposes.

c. Summarize evidence that an irrigation system reduces the element of chance in the growing of crops.

d. Write a paragraph on the primary purpose of irrigation.

e. Write in ten sentences the main things a man would want to know before deciding to locate on an irrigation project.

References:

Judd and Marshall: *Lessons in Community and National Life*, Series C. Bureau of Education, Washington, D.C., pages 41–49.

Mead: *Federal Reclamation, What it Should Include.* United States Department of the Interior, Washington, D.C.

Federal Irrigation Projects. United States Department of the Interior, Washington, D.C.

The World Book.

Geography Series, Study Guide No. 9

BITUMINOUS COAL

I. General Survey.

a. Be prepared to discuss:

(1) Tunnels and shafts in coal mines.
(2) Process of mining coal.
(3) Safety in the mine.
(4) Coke making.

Note — Coal deposits are formed from the remains of plant life buried under varying depths of rock and soil. Bituminous, or soft coal, as it is commonly called, is found in unfolded layers ranging from a fraction of an inch to several feet in thickness. The coal may be reached by a shaft sunk vertically into the earth or by a tunnel that slopes down gradually to the level of

the coal. Elevators are used in shaft mines for carrying both miners and coal. In slope mines, cars, with steel cables to control them, are used for entrance and exit. Branch tunnels lead from the shaft or slope tunnel to the mine breasts where the coal is mined. Bituminous coal mining is done largely by machinery. Gas, water, and the caving in of roofs are the most serious dangers that the miner meets. Safety lamps, constant inspection, and strong supports for roof and wall have done much to lessen the danger in mining.

Nearly half the soft coal output of the world is mined in the United States. This coal is mined in thirty-six States of the Union and underlies something like four hundred and fifty thousand square miles.

When soft coal is heated without enough air to burn it, oils and gases are driven off leaving a hard, light, and porous material, grayish in color, called coke. Many by-products are made from the oils and gases, while the coke is used for industrial and domestic heating.

b. *Locate the Pennsylvania bituminous coal region. Find out to what centers bituminous coal is transported from this region.*

c. *Be prepared to report on the topic assigned you from the following list:*
   (1) How bituminous and anthracite coal are formed.
   (2) The dangers in coal mining.
   (3) Labor saving and safety devices used in coal mining.
   (4) Uses of coke.
   (5) Some important by-products of coke making.

II. The Mining of Bituminous Coal.

a. *Be prepared to discuss:*
   (1) Slope and shaft mines.
   (2) Digging the coal.
   (3) Safety in coal mines.
   (4) Carrying coal out of a mine.
   (5) Cleaning and sorting the coal.

b. *Explain how mechanical equipment has been an advantage in bituminous coal mining.*

III. Coke Making.

a. *Be prepared to discuss:*
   (1) Carrying coal to coking ovens.

(2) Preparing coal for coking.
(3) Coking in beehive ovens.
(4) Coking in retort ovens.
(5) The by-products of the coking process.
(6) Location of coking plants.

b. Explain how coke is made at your local gas plant.

IV. Reorganization Review.

a. Report on assigned topics.

b. Discuss the need for conserving coal, bringing out the following points:

(1) The uses of coal and coke in modern life, naming things you use and see about you, into the production of which coal has not entered in some way or other.
(2) Why the supply of coal is limited and cannot be replaced after it is used.
(3) Why all the coal in a mine cannot be mined.
(4) How the production and use of coal in the United States have increased since 1900.
(5) How coal is wasted, and how the waste may be reduced.
(6) Why the smoke nuisance should be abated.

c. Have pupils explain, in ten written sentences, the need for the conservation of coal and ways in which it may be conserved.

References:

Tappan: *Diggers in the Earth,* chap. I. Houghton Mifflin Company.
The Story of Coal. D. Appleton and Company.
Reports of the United States Bureau of Mines.
United States Census Report — Section on Mines.

Geography Series, Study Guide No. 10

IRON ORE TO PIG IRON

I. General Survey.

a. Be prepared to discuss:

(1) Mesabi iron ore mines.
(2) Shipping Mesabi ore by way of the "Soo" Canal.
(3) Smelting iron ore.

b. Locate on a map the Mesabi mines and trace the route from them through the "Soo" Canal to Gary, Indiana, Cleveland, Ohio, and Pittsburgh, Pennsylvania.

c. Be prepared to report on the topic assigned you from the following list:

(1) The Mesabi mines.
(2) Ore boats on the Great Lakes.
(3) The "Soo" Canal.
(4) Blast furnaces.

II. Large Scale Iron Ore Mining.

a. Be prepared to discuss:

(1) Steam shovels in iron ore mining.
(2) The over-burden of soil.
(3) Terrace mining.
(4) Carrying ore from a Mesabi mine.
(5) Open pit and shaft mines.
(6) Density of population in Mesabi region.
(7) Scale of mining in Mesabi region.

Note — The Mesabi district extends for about one hundred and fourteen miles and contains many mines. A mine may be two and a half miles long, three quarters of a mile wide, and three hundred to four hundred feet deep. About seventy feet of earth covers the ore, which is largely iron rust. The ore looks very much like coarse, red sand. Steam shovels weighing three hundred tons lift sixteen tons of ore at one scoop and load sixty scoops an hour into railroad cars. It costs from four to sixteen cents to mine a ton of ore in the Mesabi mines.

III. Transporting Iron Ore.

a. Be prepared to discuss:

(1) Ore boats.
(2) Loading ore boats.
(3) Locking ore boats through "Soo" Canal.
(4) Unloading ore boats at receiving port.
(5) Transporting iron ore by water.
(6) The movement of ore boats from shipping and receiving centers.

Note — Ten thousand tons of ore may be loaded into a boat from cars on a pier in twenty-five minutes. It takes something less than three hours to unload the ten thousand tons from the boat. The level of Lake Superior is about twenty feet above

that of the other Great Lakes. The "Soo" Canal was built to avoid the rapids, and locks are used to raise boats to the level of Lake Superior or lower them to the level of the other lakes. Ore boats cannot use the lakes four months of the year because of the ice. During the summer, therefore, they are kept in service, with little delay at ports. Great piles of ore are thus collected at the blast furnaces in order that the furnaces may be fired continuously throughout the year. It costs about two dollars and a half a ton to deliver ore from the Mesabi mines to blast furnaces at or near the receiving ports on the Great Lakes.

IV. Smelting Iron Ore.

a. Be prepared to discuss:

(1) Coke for smelting.
(2) Limestone for smelting.
(3) Smelting iron ore.
(4) Slag.
(5) Molten iron.
(6) Transporting molten pig iron.
(7) Molding pig iron.
(8) Blast furnace fires.
(9) Supply of ore for smelting.

Note — The Mesabi ore is largely a compound of iron and oxygen, that is, burned iron. The oxygen from the ore leaves the iron to unite with the carbon of the coke. The molten iron, free from oxygen, sinks to the bottom of the furnace as pig iron. Foreign substances in the ore are melted with the limestone and float on the molten iron in the form of slag which is used for railroad ballast and in the making of cement and fertilizer. In the days when the usual practice was to draw off the molten iron into sand troughs, the rows of metal branching from the main trench were thought to resemble a litter of pigs, hence the name "pig" iron. Sometimes the iron is not molded into pigs but is carried in a molten state to refining furnaces where it is converted into steel. In such cases the material is not allowed to cool from the time it enters the blast furnace until it comes from the steel mill as a finished product.

V. Reorganization Review.

a. Report on assignments.

b. Be prepared to discuss:

(1) Location of Mesabi ore mines relative to dense population and supplies of coke.

(2) Location of the market for pig iron relative to dense population and supplies of coke.
(3) Why ore goes to pig iron market, rather than coke to the ore mines.

c. *Make a design to show mine, blast furnace, and connecting link between them. Letter diagram with brief descriptive titles as follows:*
(1) At mine — how ore is mined.
(2) On lakes — why ore is carried to neighborhood of pig iron market.
(3) At "Soo" Canal — why locks are used.
(4) At blast furnace — how iron is smelted.

References:

Resources, Industries and Cities. Social Science Pamphlets of Lincoln School, Columbia University, pages 181–91.

Judd and Marshall: *Lessons in Community and National Life,* Series C. Bureau of Education, Washington, D.C., pages 81–89.

Chase and Clow: *Stories of Industry,* vol. I. Educational Publishing Company, pages 63–98.

Eva M. Tappan: *Diggers in the Earth.* Houghton Mifflin Company, pages 57–64.

J. Russell Smith: *The Story of Iron and Steel.* D. Appleton and Company.

General Science Series, Study Guide No. 11

(Reproduced in full on pages 7–12.)

General Science Series, Study Guide No. 12

ATMOSPHERIC PRESSURE

I. General Survey.

a. *Be prepared to discuss:*
(1) Air as a real substance.
(2) Air pressure.
(3) Pressure *versus* suction.

Experiment: Tie a piece of thin rubber over a bladder glass on an air pump. Remove some of the air. Allow the air to reenter the glass. Then place a glass plate over the rubber.

making the joint air-tight with vaseline. Again remove some of the air.

(4) Direction of atmospheric pressure.

EXPERIMENT: With the rubber sheet depressed as in the first part of the preceding experiment, turn the air pump on its side and invert it.

b. Prepare for report the topic assigned your group from the following list:

(1) Proofs that the atmosphere exerts pressure.
(2) Using unbalanced atmospheric pressure to do work.
(3) Types of instruments for measuring atmospheric pressure, and their use.
(4) Variations in atmospheric pressure — their cause and significance.

II. UNBALANCED AIR PRESSURE.

a. Be prepared to discuss:

(1) Displacement of air by moving objects.
(2) Effect of displacement of air.
(3) Why mercury rises in a barometer tube.
(4) Why Magdeburg hemispheres are held together when air is removed from them.
(5) How a water pump works.

NOTE — A cubic foot of water weighs about 62.4 pounds.

(6) Reasons for believing that atmospheric pressure at sea level is equal to about fifteen pounds per square inch.

III. VARIATIONS IN ATMOSPHERIC PRESSURE.

a. Be prepared to discuss:

(1) Effect of a difference in pressure on opposite sides of a flexible disc.
(2) Effects of altitude on atmospheric pressure.
(3) The weight of warm air and cold air.

IV. REORGANIZATION REVIEW.

a. Be prepared to give assigned reports.

b. Be prepared to discuss:

(1) Evidence that air is pulled towards the earth by gravity.

(2) Evidence that air, being mobile, tends to transmit pressure equally in all directions.
(3) The extent and pressure of the atmosphere ocean.
(4) Effect of pressure of fifteen pounds per square inch.
(5) Why changes in air pressure may result in winds.

c. *Paste in a notebook a picture illustrating each of the following:*

Airplane	Medicine dropper	Suction pump
Balloon	Nonskid tires	Vacuum cleaner
Breathing	Sealing fruit jars	
Drain pipe pump	Siphons	

A brief, concise sentence showing how atmospheric pressure is utilized in each case should accompany each picture. Select the best exhibit and place it in the "display notebook."

References:

D. Archibald: *The Story of the Earth's Atmosphere*, pp. 25–31.
A. Williams: *Thinking it Out*, pp. 217–26.
Taylor Instrument Company: *The Barometer Book.*
Taylor Instrument Company: *The Barometer as the Foot Rule of the Air.*

General Science Series, Study Guide No. 13

COMPRESSED AIR

I. General Survey.

a. *Be prepared to discuss:*
(1) Ways of compressing air.
(2) Evidence that compressed air is elastic.
(3) Evidence that compressed air can do work.
(4) Practical applications of compressed air.

b. *Be prepared to report on topic assigned you from the following list:*
(1) Air pumps.
(2) Spraying machines.
(3) Air-driven automatic tools.
(4) The railway air brake.

II. The Elasticity of Compressed Air.

a. *Be prepared to discuss:*
(1) How an air pump compresses air.

(2) How air is pumped into an automobile tire.
(3) Reasons for compressing air in automobile tires and shock absorbers.
(4) How pressure is affected when mass of air in a given container is doubled.

NOTE — Demonstrate relation between pressure and volume with Boyle's Law apparatus.

(5) How a sprayer works.
(6) How air dome of fire engine affects stream of water thrown.

NOTE — Demonstrate action of force pump with glass model.

(7) How a sand blast works.

b. Summarize evidence that compressed air is elastic.

III. THE EXPANSION OF COMPRESSED AIR.

a. Be prepared to discuss:

(1) Compressed air riveting machines.

NOTE — In the valve hammer compressed air rushes into the cylinder and drives a movable block or piston against the tool in the end of the cylinder, making about 35 long, hard strokes a minute. The valveless hammer as used in router for carving wood and stone makes about 250 light strokes a minute.

(2) Compressed air carving tools.
(3) Air brakes on trains.

NOTE — Have pupils explain, with the aid of the blackboard diagram, the principle of the air brake system. A steam-driven pump on the side of the engine forces air at a pressure of about 80 pounds per square inch into a tank on the engine which supplies the air reserve tank under each car through the main air line. When the pressure in the main line is reduced, the triple-action valves turn so that the compressed air in the reserve tank under each car is let into the brake cylinder where it forces out a piston that sets the brakes on the car wheels.

(4) Air brakes and safety of travel.
(5) Compressed air and musical instruments.
(6) Compressed air in steel making.

IV. Reorganization Review.

a. Report on assignments.

b. Review uses of compressed air:

(1) How air is compressed.

(2) How it operates.

c. Discuss:

(1) Advantages in being able to compress air by machinery, and to carry it in pipes to the point where work is to be done.

(2) How compressed air releases energy equivalent to that used in compressing it.

(3) How energy of compressed air may be applied more advantageously than human energy.

Note — The value of man's energy at current horse-power rates amounts to about one half cent a day.

(4) How compressed air devices illustrate how man magnifies his own strength by setting the forces of nature to work for him.

d. Select best reports from each of the four groups and place them in display notebook used for Atmospheric Pressure assignments.

e. Write a brief account of the advantages derived from the use of compressed air.

General Science Series, Study Guide No. 14

WATER CYCLE

I. General Survey.

a. Be prepared to discuss:

(1) Cloud formation.

(2) Precipitation.

(3) What happens to the water precipitated from the clouds.

b. Summarize the main steps in the water cycle.

c. Be prepared to report at the next class period on the assignment given you from the following list:

(1) Experiments to show the conditions which influence rate of evaporation.

(2) The approximate height and speed of movement of different types of clouds.

(3) The relations of types of clouds to the weather to be expected.

II. Evaporation.

a. Be prepared to discuss:

(1) Conditions that influence the rate of evaporation of water.

Note — Demonstrate assigned experiment to show relation between air currents and rate of evaporation. Place the same amount of water in each of two flat dishes the same size. Put one in the current of air from an electric fan. In which is evaporation more rapid?

Note — Demonstrate assigned experiment to show relation between temperature and rate of evaporation. Place the same amount of water in each of two flat dishes of the same size. Heat one. In which is evaporation more rapid?

Note — Demonstrate assigned experiment to show relation between extent of evaporating surface and rate of evaporation. Place the same amount of water in each of two dishes, one broad and shallow, the other tall and narrow. In which does evaporation proceed more rapidly?

(2) Why water vapor rises.

(3) How clouds are formed from water vapor.

Note — Make assigned report on height and movement of clouds.

(4) How the moisture is distributed by clouds.

Note — Make assigned report on clouds and weather.

b. Summarize evidence that water passes from earth to air by the process of evaporation.

Note — Yearly evaporation from land surfaces, 23,270 cubic miles; yearly evaporation from ocean surfaces, 93,121 cubic miles; precipitation on entire earth, 115,391 cubic miles. Distributed evenly over the earth this would be 37 inches deep. Only about 7 per cent of the water evaporated from the ocean is precipitated on the land. Of all precipitation on lands draining into the ocean 78 per cent is furnished by evaporation from the area itself.

c. Be prepared to report at next class period on topic assigned you from the following list:

(1) Regions of heavy and light rainfall.
(2) Occurrence and effects of glaciers.
(3) The relation of forests to floods.

III. THE CONDENSATION OF WATER VAPOR AND RUN-OFF OF WATER.

a. Be prepared to discuss:

(1) Conditions necessary for the formation of rain or snow.

NOTE — Give report assigned on regions of heavy and light rainfall.

(2) Underground water.

(3) Surface water.

NOTE — Report on assignment: Occurrence and effects of glaciers.

(4) How forests affect the run-off of surface water.

NOTE — Report on assignment: The relation of forests to floods.

b. Summarize evidence to prove that water passes from the air to the earth by the process of condensation.

NOTE — During the vegetative season trees, shrubs, and grasses each transfer approximately 500 lbs. of water for each pound of dry leaf material.

To produce one pound of dry wood in a tree from 500 lbs. to 1000 lbs. of water must pass through the tree. In an acre of woods two and a half to four million lbs. of water will pass through the trees into the air. This water if condensed would cover an acre of land with water 12 inches deep.

IV. REORGANIZATION REVIEW.

a. Discuss significance of water cycle.

(1) Relation of heat to evaporation and condensation.
(2) How winds effect a wide distribution of water.
(3) The work of underground water.
(4) The work of surface water.
(5) Importance of wide distribution of water.

b. Write a brief description of how all life is dependent upon the continuous operation of the water cycle.

General Science Series, Study Guide No. 15

NEW YORK WATER SUPPLY

I. General Survey.

a. Be prepared to discuss:

(1) The appearance and surroundings of New York City.

(2) The Catskill watershed.

(3) Conveyance of water from the Catskills to New York City.

(4) Distribution of water to New York City.

b. Locate on map the Catskill Mountains, and trace route followed by water supply to New York City.

c. Be prepared to report on topic assigned you from the following list:

(1) How camps and settlements were located with reference to water in pioneer days.

(2) How water may be polluted.

(3) How a forest cover protects the water of a watershed from pollution.

(4) How the water of the Hudson River is polluted.

(5) How Los Angeles gets its water supply.

II. The Need of New York City for Water.

a. Be prepared to discuss:

(1) Location of New York City in relation to water.

(2) The population of New York City.

(3) Skyscrapers and the water supply.

(4) Central Park.

(5) The growth of New York City.

Note — The continual and steady growth of New York City is one of the outstanding features in American life. Building construction is going on continually. Twenty-story buildings are being torn down and replaced by fifty-story buildings. Underground subways are being enlarged and extended. New tunnels and new bridges are being built across the Hudson River. It is estimated that several millions of people come in and leave Manhattan every day.

III. Catskill Watersheds and the Collection of Water.

a. Be prepared to discuss:

(1) Why the Catskill watersheds were chosen as a source of water supply.

(2) The Schoharie and Ashokan Reservoirs.

(3) Measuring the water supply.

(4) Aerating and chlorinating water.

Note — The backing up of water by the Gilboa Dam submerged the sites of seven villages, thirty-two cemeteries, eleven miles of railroad, and sixty-four miles of highway.

The area of the watershed now used for New York water supply system is five hundred and seventy square miles. It is a sparsely settled area, heavily wooded, which contributes greatly to the purity of the water.

The main storage reservoir is Ashokan Reservoir with an area of twelve and a half square miles and holding enough water to supply New York for three months. Its watershed is two hundred and fifty-seven square miles. North of this area and separated by a range of mountains is another watershed of three hundred and fourteen square miles. The water from this area is collected by the Schoharie Reservoir and conveyed to the main reservoir by an eighteen-mile tunnel, six hundred feet below the mountain ranges. This is one of the greatest engineering feats in this country. The water flowing through this tunnel is measured by a Venturi meter. There are several of these meters along the water line to New York City which uses over a billion gallons per day. There is a third watershed in the Catskill Mountains, southwest of the present area, called the Roundout Watershed. It is expected that this additional supply will be needed within the next ten years.

Where the water leaves Ashokan Reservoir, there is a large aerator basin. This consists of a large number of small fountains, which throw the water into the air, converting it into a fine spray, thus eliminating disagreeable tastes and odors. A second aeration takes place at Kensico Reservoir.

Chlorinating plants at Ashokan, Kensico, and Hillview Reservoirs sterilize the water, rendering it entirely pure.

The water is measured as it leaves Ashokan, Kensico, and Hillview Reservoirs. Venturi meters, used for this purpose, are short tunnel sections, greatly reduced in cross-section similar to the contraction of an hour glass. Accurate instruments are attached here to measure the volume of water passing. The three meters installed in this system are the largest ever built, being 410 feet long, and the contracted section 7 feet 9 inches in diameter.

IV. STORAGE AND DISTRIBUTION OF WATER IN A CITY SYSTEM.

a. Be prepared to discuss:

(1) The Hudson River Tunnel.

(2) Storage reservoirs.

(3) Distribution of water to New York City.

(4) How a city uses its water.

NOTE — The Hudson River pressure tunnel is built 1100 feet underneath the Hudson River through solid rock. The crossing at Stormking and Breakneck Mountains was chosen because that is where the river narrows down to its shortest width, and also because here was solid rock right to the edge of the river. Even at that, this tunnel is 3000 feet long. The engineers had to devise a method of pumping this tunnel out for cleaning purposes, and the building seen at the foot of the mountain contains a huge metal piston, 40 feet high, which is used for pumping out the water. This is, however, only done about once in ten years. The Kensico Reservoir contains a week's supply of water. Here it is again aerated and chlorinated. The Hillview contains a day's supply and feeds directly into the Manhattan Tunnel. This tunnel is 200 feet below street level in solid rock, and is 18 miles long. It goes down to 750 feet below street level where it crosses the East River over to Brooklyn. A flexible pipe line 6 feet in diameter runs across the Narrows from Brooklyn to Staten Island.

During the long storage which the water receives, the processes of sedimentation, bleaching by the sun, oxidation by the winds, and sterilization by natural processes go on more or less continuously.

V. REORGANIZATION REVIEW.

a. Report on assignments and discuss them.

b. Discuss the services rendered in constructing and operating the New York supply system by each of the following:

(1) Lawyers.

(2) Sanitary engineers.

(3) Surveyors.

(4) Chemists.

(5) Miners.

(6) Bankers.

(7) Newspapers.

(8) Farmers.

(9) Steel workers.

(10) Railroads.

c. Write a brief description of your local water supply system.

Reference:

The Catskill Water Supply. Board of Water Supply of the City of New York, January, 1926.

General Science Series, Study Guide No. 16

PURIFYING WATER

I. General Survey.

a. Be prepared to discuss:

(1) The removal of sediment from city water.

(2) The filtering of water.

(3) The sterilizing of water.

b. Prepare a report on how your local water supply is purified and also on the topic assigned from the following list:

(1) The proper location and construction of wells.

(2) The relation between typhoid fever and the water supply.

(3) The use of iodine in city water and its effect on goitre.

(4) The work of a city board of health.

II. Removal of Sediment from Large Quantities of Water.

a. Be prepared to discuss:

(1) The Lake Michigan intake tunnel for Chicago water supply.

(2) Sedimentary material.

(3) Rate of sedimentation.

(4) Filtration.

(5) The cleaning of filters.

b. Summarize the evidence that city purifying plants are designed to remove sediment from large quantities of water.

III. Sterilizing City Water.

a. Be prepared to discuss:

(1) How water may be contaminated.

(2) The use of chlorine.

(3) Testing city water.

(4) Training for bacteriologists.

(5) Aeration of water.

IV. Reorganization Review.

a. Report on assignments and discuss; then discuss how build-

ing and equipment of the purifying plant indicate that specialized knowledge and skill were employed in their construction.

b. *Explain why the securing of a city water supply is a specialized service that must be supported by the community.*

c. *Discuss the reasons why a city water supply should be under the control of the board of health.*

d. *Write a brief account of how water is purified for use in your home city.*

General Science Series, Study Guide No. 17

LIMESTONE AND MARBLE

I. General Survey.

a. *Be prepared to discuss:*

(1) Use of limestone.
(2) Limestone for road building.
(3) Quarrying and dressing limestone for building purposes.
(4) The use of marble.

b. *Prepare a report on the topic assigned you from the following list:*

(1) The origin of limestone and marble.
(2) How lime is made and used.
(3) How cement is made and used.
(4) How limestone and marble are quarried and dressed.
(5) The marbles of Italy and Greece.
(6) Tennessee and Vermont marbles.

II. Texture, Composition, and Uses of Limestone.

a. *Be prepared to discuss:*

(1) How limestone is used for road building.
(2) Dolomite for road metal.
(3) The transportation of stone.
(4) The nature and use of chalk.
(5) Bedford limestone.
(6) Quarrying limestone.
(7) Dressing limestone.

Note — About eighty per cent of the building limestone comes from two counties in Indiana near Bedford and Blooming-

ton. The rock exists there in beds thirty to forty feet thick. It is compact in structure, fairly soft, and easily worked when first quarried, but becomes hard with continued exposure to the air.

III. LIME AND CEMENT.

a. Be prepared to discuss:

(1) How lime is made.

NOTE — A pupil will demonstrate the effect of temperature by heating broken limestone in an iron dish to a very high temperature, show the resulting lime to the class, add water and sand to produce mortar, and illustrate its use by packing it between two samples of limestone as a stone mason does in building a wall.

A pupil will place on the blackboard a cross-section diagram of a vertical cylindrical lime kiln, and explain how the fire at the base sends hot gases through the limestone driving off the water and decomposing the stone to lime and carbon dioxide.

(2) How lime is used.

(3) How cement is made.

NOTE — A pupil will demonstrate the making of concrete by mixing four parts of sand and one part of cement with enough water to make a thick paste. This will gradually harden to make concrete.

(4) How cement is used.

NOTE — Limestone and clay or limestone and blast furnace slag are burned together to produce Portland cement — so called from its resemblance to an English building stone — Portland stone. The plants are near the sources of material as 1.7 tons of raw materials are required for one ton of cement. The source must last for a long time and be comparatively uniform. The limestone is blasted from the quarry and loaded into cars which transport it to the cement mill. Here the ingredients are crushed separately and then mixed in definite proportions. The mixture is recrushed, dried, and pulverized. The powdered mixture enters one end of one of the rotary kilns, which vary from one hundred to two hundred and fifty feet in length and from six to ten feet in diameter. Some combustible material, such as gas or powdered coal, is blown into the lower end of the kiln where it produces flames which extend from one sixth to one third the length of the kiln. A kiln one hundred feet long and eight feet in diameter will produce six hundred barrels of cement

a day and use eighty pounds of coal per barrel. The material, as it passes through the rotating kiln, is first dried, then loses its carbon dioxide and any other organic material. Thus clinker is formed. Sometimes the clinker forms rings in the kiln. These are broken up without stopping the kiln by shooting a notch out of the ring. From five hundred to one thousand shots are sometimes required. The clinker is about one fourth to two inches in diameter as it drops from the kiln. It is then ground into cement which must be so fine that seventy-eight per cent will pass through a sieve with two hundred wires to the inch. Such a sieve will hold water. The cement flows into the bags through a self-closing valve, which closes after the bag has been tied up. When ninety-four pounds have been placed in a bag it is automatically released by a scale and carried by a moving belt to a freight car. Ten men can fill and load four thousand sacks a day as compared with eight hundred sacks a day under the old system of hand weighing.

IV. Marble.

a. Be prepared to discuss:

(1) Quarrying marble.

(2) The use of marble.

Note — Marble is a metamorphic crystalline rock produced from limestone by natural heat and pressure. Because of its close structure it takes a polish of extreme fineness. Marble is variously colored by impurities and fossil remains. Its markings may be matched up to make decorative patterns. Statuary marble is fine-grained, uniform in texture, and usually pure white due to the fact that staining materials were not present in the limestone from which the marble was formed. Some marble columns are produced in one piece, but most columns are made up in sections. The columns of the Lincoln Memorial, shown at the end of the film, contain some of the largest sections ever produced. Each has a diameter of eighty-nine inches and a length of fifty-eight inches.

b. Examine and describe samples of polished marbles.

V. Reorganization Review.

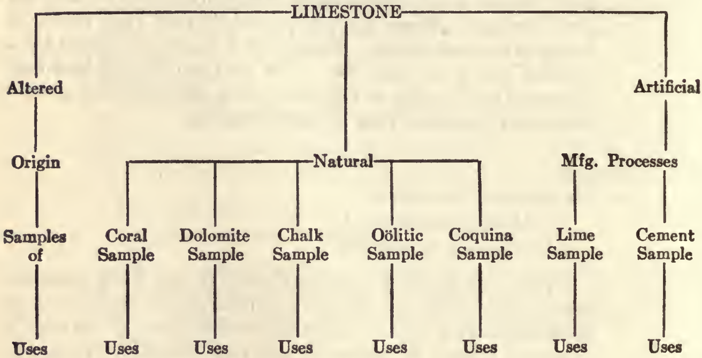
a. Give assigned reports.

b. Discuss how abundance of limestone and marble favors their extensive use for construction purposes.

c. Prepare a limestone and marble display. This should include:

(1) Samples of natural limestone, e.g., coral, chalk, coquina, dolomite, and oölitic limestone, with paragraphs telling the origin and uses of each.
(2) Samples of artificial limestone, e.g., lime and cement, each with a paragraph telling how they are made and some of their uses.
(3) Samples of altered limestone, e.g., marble, with a paragraph explaining its origin and use.

LIMESTONE DISPLAY



References:
Kingsley: *Town Geology.* The Macmillan Company.
Huxley: *The Story of a Piece of Chalk.* D. Appleton and Company.
Tappan: *Diggers in the Earth,* chap. II. Houghton Mifflin Company.

General Science Series, Study Guide No. 18

SAND AND CLAY

I. General Survey.

a. Be prepared to discuss:

(1) Evidence that sand and clay are derived from granite.
(2) Natural and artificial products from sand.
(3) Natural and artificial products from clay.

b. Be prepared to report on the topic assigned your group from the following list:

(1) The origin, composition, and structure of granite.
(2) How sandstone is formed, quarried, and used.
(3) Rock crystal, how it is dressed and used.
(4) The history of glass making.
(5) The history of brick and pottery making.
(6) How chinaware is made.

II. Artificial and Natural Sandstones.

a. Be prepared to discuss:

(1) The origin of sand.
(2) Durability of sand.
(3) Making sandstone blocks.
(4) Natural sandstone.
(5) Quarrying sandstone.
(6) The uses of sharp-grained sand.

Note — Sand is unaltered quartz. It is found in such great abundance because the ordinary agents that decompose other minerals act upon it but slightly. Sandstones, either natural or artificial, are made by cementing grains of sand with lime or some other soluble material. If the coating on the sand grains that cements them together is thick it weakens the rocks, since the cementing material is not so strong as the sand particles. Brown sandstone is cemented by iron oxide and is very durable because it is but slightly affected by water and other decomposing agents, the iron already having been weathered to form the oxide. Sand carried considerable distances by water has its corners worn off and for that reason river sand is usually so rounded that it affords poor cutting edges for grinding and less surface for cementing plaster than sharp-grained sand.

b. Examine specimens of quartz, flint, jasper, chalcedony, and obsidian, and describe each.

III. Glass Making.

a. Be prepared to discuss:

(1) The ingredients used in making glass.
(2) Mixing the ingredients.
(3) Crucibles for carrying molten glass.
(4) Melting the ingredients.
(5) Rolling glass.

(6) Annealing the glass.
(7) Polishing plate glass.
(8) Storing plate glass.
(9) Shipping plate glass.
(10) The uses of plate glass.

NOTE — The pots used in glass making must be strong enough to hold 3000 pounds of glass at a temperature of 2500 degrees for about 24 hours. It takes three years to make one of the pots, but they last less than three weeks in service. A 25-ton cylinder set at the desired height from the table rolls the molten material into sheets of plate glass. The men working on plate glass press it into a thin layer of plaster of Paris, which dries and holds it while it is being ground and polished.

b. A pupil will demonstrate to the class how glass is made by mixing and fusing in a fire brick crucible the following:

100 grams of sand.
35 grams of sodium carbonate.
15 grams of calcium carbonate.

See *Chemistry in Industry* — Volume I, page 132.

IV. Clay and Clay Products.

a. Examine a piece of decayed granite. Pick out the feldspar crystals and describe their general form.

NOTE — Clay is produced when feldspar is altered by weathering. Grains found at the spot where they were formed by the disintegration of feldspar are usually pure and clean and make white pottery. Grains washed away from the original source, while fine-grained, are mixed with foreign materials which spoil them for pottery making.

b. Be prepared to discuss:

(1) Origin of clay.
(2) Slate quarrying.
(3) Brick making.
(4) Pottery making.

V. Reorganization Review.

a. Give assigned reports.

b. Consider the construction of a brick house with stone trimmings. Choose a material for each of the uses below and give your reasons for the choice:

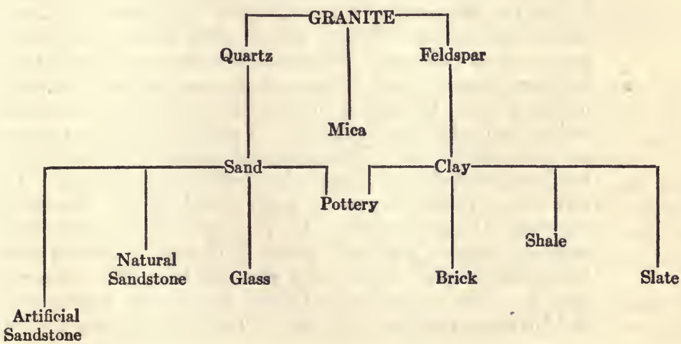
(1) Foundation.

(2) Stone trimmings.
(3) Plaster on walls.
(4) Main walls.
(5) Windows.
(6) Roof.
(7) Tiles for mantels.

c. *Collect and mount samples of granite and the rocks obtained from it, and arrange in the following sequence:*

(1) A sample of granite, with a paragraph explaining the origin, structure, and decomposition into quartz, feldspar, and mica.
(2) A sample of quartz, of feldspar, and of mica, with a descriptive paragraph for each.
(3) Samples of sand and clay, each accompanied by a paragraph explaining its origin.
(4) A sample of natural sandstone and of artificial sandstone block, with a paragraph for each explaining origin and method of manufacture, respectively.
(5) A sample of plate glass, with paragraph explaining ingredients and manufacturing process.
(6) Samples of shale, slate, and brick, with paragraphs explaining origin or manufacturing process.
(7) A sample of pottery, with a paragraph explaining ingredients and manufacturing process.

GRANITE DISPLAY



References:

Kingsley: *Town Geology.* The Macmillan Company.

Starr: *First Steps in Human Progress.* Chapter on "Pottery Making."

Tappan: *Diggers in the Earth,* chaps. II, III, IV. Houghton Mifflin Company.

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General Science Series, Study Guide No. 19

REFORESTATION

"*When you help to preserve our forests or plant new ones you are acting the part of a good citizen.*" — Theodore Roosevelt.

I. General Survey.

a. Be prepared to discuss:

(1) Heavily wooded forest area.

(2) Soil erosion in cut-over areas.

(3) A tree nursery.

(4) The process of reforesting an area.

(5) The slow growth of trees.

Note — In three hundred years the population of the United States has grown from a few settlers on the Atlantic seaboard to about one hundred and twenty millions, while the timber area has decreased from eight hundred and twenty-two million to three hundred and eighty-four million acres. Forests are disappearing four times as fast as they are being replenished. Five million telephone and telegraph poles are used each year. It takes sixteen acres of spruce to make one edition of a large Sunday newspaper. Twelve million acres are cut over every year for board lumber. Twenty-nine million acres of timberland were burned over in 1924, at a loss of one hundred thousand dollars a day. It takes from forty to sixty years for trees to reach a profitable size for cutting. Twelve acres of trees forty-six years old were cut in Massachusetts recently, yielding nearly five hundred dollars an acre for box lumber on the stump. At this rate, a thousand acres of forest would insure a school or community a gross income of ten thousand dollars a year, and could be made a perpetual source of income by cutting and replanting twenty of the acres annually after fifty years of growth. The average annual profit per acre in Switzerland and Germany has been given at $6.20 and these forests are the

chief support of many towns. Forests planted on watersheds, supplying city water, yield a cash return and serve as a protection against floods and contamination. In New York State alone there are now over forty city forests.

b. *Be prepared to report on the topic assigned you from the following list:*
   (1) The rate at which the United States has used up its timber supply.
   (2) The effect of a forest cover on soil and on the run-off of water.
   (3) How the timber supply of the United States may be conserved by careful harvesting and reforestation.
   (4) The superiority of nursery seedlings over wild seedlings for reforestation.
   (5) Reforestation activities in the United States.

c. *Locate on a map of the United States each of the following:*
   (1) Areas in which are located our greatest remaining virgin forests.
   (2) Areas which should be reforested.

II. The Need for Reforestation.

a. *Be prepared to discuss:*
   (1) Wasteful practices in the cutting of timber.
   (2) How fire hazards may result from timber cutting.
   (3) The retarding of water run-off.
   (4) Protection of soil from erosion.
   (5) Effect of deep-rooted trees upon fertility of soil.
   (6) Effect of wasteful cutting on pure water supply for lowlands and valleys.

Note — Great waste in timber, water, and soil result from destruction of forests. It was estimated fifty years ago that Wisconsin had enough forests to supply the country with timber for a hundred years but these forests were cut by timber companies which had no desire to reforest, with the result that very little now remains. Small trees were destroyed by careless felling of larger trees and others were ruthlessly cut out for making logging roads. What has happened there has been happening throughout the east and middle west.

Great timber waste has also occurred because trees are cut too far from the ground and a tall stump left; the tops and

branches are cut off and left behind although much of this wood could be used for pulp or fire wood. This débris constitutes one of our greatest fire hazards. Many logs are destroyed or lost on the way to the lumber mill and there, too, the sawing is done wastefully. Frequently, short pieces and remnants are burned up to get rid of them.

The Ohio River furnishes a good example of waste of water as the result of deforesting the Allegheny Mountains. What was formerly a navigable stream is now a very unreliable waterway, overflowing in the spring and becoming too shallow for navigation in the summer. All the water washes away in the spring floods and the streams fail to furnish a regular and adequate supply of water to the lowlands and valleys because of the removal of the forests which have protected the sources of the streams.

In this way, too, the top soil is washed away. Because trees send their roots deep down into the soil to bring up raw food materials, the top soil not only remains fertile, but becomes more fertile from the decaying leaves and trees. When the forest cover is removed, rains, beating down upon the unprotected earth, wash away the soil accumulation of ages leaving a devastated area of waste land where once a forest flourished.

III. Growing and Caring of Tree Seedlings

a. Be prepared to discuss:

(1) Growing seedlings in a nursery.

(2) Preparing seedlings for shipping.

(3) Care of seedlings until wanted for planting.

(4) Nursery seedlings and wild seedlings.

Note — Nature's processes in the planting of trees are too slow and uncertain to meet our needs. Seeds of various kinds of trees fall together. The soil may not favor the growth of some of them and many die out in the shade of larger neighbors. It thus takes nature a great many years to reforest an open area and the trees are likely to vary greatly in kind and size. By reforesting we grow the kind and number of trees we want, where we want them. By selection of seed and experimenting in nurseries for a quarter of a century, hardier and sturdier tree seedlings have been developed. The kind of trees that should be planted in a given area depends upon the nature of the soil and the nature of the product desired, as lumber, wood pulp, posts, ties, or poles. Red pine will grow in coarse, sandy loam. It is useful for railroad ties and rough lumber. White pine requires loam for its best growth and produces telephone poles and

the best grade of pine lumber. Norway spruce and white cedar will grow on heavy soil. The former is used for wood pulp and the latter for ties, poles, and posts. Up to two years old the little trees are usually called seedlings. When over two years old they are called transplants. Seedlings ordinarily cost about two dollars a thousand as compared with four dollars a thousand for transplants. A plantation made from seedlings will usually be as large after a few years as one made from transplants. The smaller the tree, the less shock there is to it in moving from the nursery to the planting field. Transplants should be used when the young tree needs the advantage of a stronger start in order to compete with the vegetation around it. In the handling of seedlings, care should be taken at all times to keep the rootlets moist. If the rootlets are seriously injured the seedling cannot establish connection with the soil to get the minerals and water it needs for growth.

IV. Reforesting an Area with Seedlings.

a. Be prepared to discuss:

(1) Spacing of seedlings.
(2) Planting of seedlings.
(3) Advantages of reforesting with selected seedlings rather than by nature's method.
(4) Given a forested area what precautions should be taken to protect it.

Note — In planting seedlings, the hole should be deep enough to accommodate the rootlets without doubling them up, and the depth of planting should be the same as the depth at which they grew in the nursery. Close planting brings about a crowded shady condition which kills off side branches, reduces the number of knots, and results in taller trees. The stand may be thinned out from time to time by cutting out some of the trees for posts, box lumber, and other market uses. The cost of planting seedlings when paid labor is used will average about nine dollars per acre.

(5) Time required for planting.
(6) Reforestation — a community project.

V. Reorganization Review.

a. Be ready to report on and discuss topics assigned above.

b. Be ready to discuss the value of reforestation as a school project, bringing out the following points:

(1) It affords opportunity for the attainment of useful

knowledge, the solution of real problems, and the acquisition of practical experience.

(2) It calls forth a supply of energy for the benefit of the community that otherwise might be wasted.

(3) It leaves a permanent contribution to the community in the form of growing forest cover which protects the soil from erosion and continues to grow in value long after the work is done.

(4) It provides for the future a place for recreation, which has been recognized by the United States Forest Service as one of its three main objectives.

c. Make a written plan for a school project in reforestation covering the following points:

(1) Location of area to be reforested, with reasons.

(2) The kind of trees to be planted, and why.

(3) How and where seedlings are to be obtained, and why they should be supplied from a nursery.

(4) How the pupils are to be organized into groups, with a description of the exact work each group is to do, including preparing and serving lunch and disposing of waste, giving reasons for dividing the work among groups.

(5) An estimate of the time required for the trees to become large enough for cutting, of the money value of the product, and the per annum increase in value.

(6) The advantages to be derived from the project by pupils and community.

(7) List of references used in preparing specifications, giving author, title, and number of pages.

References:

Municipal or Community Forests. State of New York Conservation Commission, 1927.

Reforesting. State of New York Conservation Commission, Bulletin No. 2, 1926.

Pack, L. A.: *The Forestry Primer.* The American Tree Association, Washington, D.C.

Problems of American Industry and Business. Social Science Pamphlets of Lincoln School, Columbia University.

Pack, L. A.: *Our Vanishing Forests.* The Macmillan Company, 1923.
Nature Magazine, June, 1927, vol. IX, No. 6, pages 385–88.

GENERAL SCIENCE SERIES, STUDY GUIDE NO. 20

PLANTING AND CARE OF TREES

I. GENERAL SURVEY.

a. Be prepared to discuss:

(1) How trees increase property values.
(2) How trees are protected.
(3) How trees are transplanted.

b. Be prepared to report on topic assigned you from the following list:

(1) Damage to shade trees by insects.
(2) Fruit growing as an industry and damage to fruits by insects.
(3) Quarantine measures for control of injurious insects.

II. INSECTS AND TREES.

a. Be prepared to discuss:

(1) Life history of apple-tree tent caterpillar.

NOTE — Give reports on damage done to shade and fruit trees by insects.

(2) How insects injure trees.

NOTE — Give report on quarantine measures for control of injurious insects.

(3) How injurious insects are controlled.

NOTE — Give report on how birds help control insects.

b. Summarize the evidence that a knowledge of the life history and habits of insects is necessary to combat successfully their ravages.

c. Be prepared to report on topic assigned you for report from the following list:

(1) Kinds of trees adapted to city streets, school grounds, parks, and private lawns.
(2) Work of roots, trunk, and leaves of a tree.
(3) Grafting and its advantages.
(4) A school yard planting plan.

III. Transplanting Trees.

a. Be prepared to discuss:

(1) Why grafted trees are selected for planting.

Note — Give report on grafting.

(2) Nursery trees and wild trees.

(3) Season for transplanting.

Note — Give report on work of roots, trunk, and leaves of a tree.

(4) Pruning a tree for transplanting.

(5) Transplanting a tree.

b. Summarize advantages in securing nursery tree for transplanting.

IV. Reorganization Review.

a. Give assigned report on kinds of trees adapted for city streets, and so forth.

b. Give assigned report on school yard planting plan.

c. Write brief account of life history of one of the insects studied.

d. Write a brief account of transplanting and caring for a tree, giving reasons why it is a valuable project.

References:

A Year in the Wonderland of Trees. Charles Scribner's Sons.

Shade Trees. New York State Conservation Commission, Bulletin No. 7.

The Apple-Tree Tent Caterpillar. United States Department of Agriculture. Farmers' Bulletin No. 662.

Insects Injurious to Shade Trees. United States Department of Agriculture, Farmers' Bulletin No. 1169.

APPENDIX II

THE COMPREHENSIVE TESTS IN GENERAL SCIENCE

Test C1 is omitted because it was given only at the beginning of the experiment, and therefore does not figure critically in judging the relative gains of X and C groups. Percentages of correct answers are not given for several of the following Test C2 questions because errors were found in some copies of the scoring key after it was too late to make corrections in time for this report. The faulty keys were used only on X papers, and therefore constitute another disadvantage to the X group.

TEST C2

(Given at beginning and end of experiment.)

INITIAL PER CENT OF CORRECT ANSWERS AND PER CENT OF GAIN FOR EACH QUESTION, TAKING ALL TWELVE CITIES TOGETHER

Question	Per cent Right Initial	Per cent Gain
1. One type of thermometer consists of a glass tube filled with (1) water, (2) silver, (3) mercury, (4) brass.	X 87.2 C 97.2	5.7 0.4
2. Moisture is added to heated air by (1) evaporation, (2) expansion, (3) contraction, (4) condensation.	X 58.6 C 68.6	−.2 2.4
3. In a convection current (1) cool air rises, (2) cool air falls, (3) warm air falls, (4) air does not move.	X 40.4 C 53.0	15.0 16.3
4. A thermometer measures (1) temperature, (2) humidity, (3) atmospheric pressure, (4) speed.	X 88.8 C 97.9	−.3 −2.3
5. The temperature in a modern classroom can be regulated automatically by (1) thermometer, (2) thermostat, (3) barometer, (4) speedometer.	X 30.1 C 30.4	38.2 20.5
6. In a room the flow of cold air toward the source of heat is greatest (1) near the ceiling, (2) along the floor, (3) in the middle, (4) along the walls.	X 52.0 C 61.9	13.5 15.9
7. A healthful temperature for a classroom is about (1) 50 to 60° F., (2) 65 to 70° F., (3) 70 to 75° F., (4) 80 to 85° F.	X 53.8 C 63.9	16.0 12.7
8. The most important advantage of a modern heating system as compared with the fireplace or stove is that (1) fuel costs are reduced to less than half, (2) heat is	X 73.0 C 84.5	15.4 12.4

Question	Per cent Right Initial	Per cent Gain
distributed more evenly, (3) it is easy to operate, (4) radiators make a room more attractive.		
9. The reason for using fans in a hot air heating system is to (1) keep the children cool, (2) keep the windows closed, (3) keep up the circulation of warmed fresh air, (4) prevent drafts.	X 67.0 C 85.0	9.6 9.2
10. Moisture is added to warmed air because (1) dry air is unhealthful, (2) it keeps the building from catching on fire, (3) it prevents the air from becoming too warm, (4) it makes the room more easily lighted.	X 55.2 C 66.4	19.2 19.0
11. If the atmospheric pressure inside a sealed can is much less than the atmospheric pressure outside, the can will (1) explode, (2) collapse, (3) remain unchanged, (4) melt.	X 33.4 C 39.1	53.6 46.2
12. The atmosphere at sea level presses down with a force which averages about (1) 5 pounds to the square inch, (2) 15 pounds to the square inch, (3) 30 pounds to the square inch, (4) 50 pounds to the square inch.	X 39.7 C 48.0	29.4 21.4
13. Atmospheric pressure at sea level will hold up a column of mercury about (1) 15 inches high, (2) 30 inches high, (3) 32 feet high, (4) 50 feet high.	X 40.4 C 46.6	13.5 21.5
14. Atmospheric pressure at sea level will support a column of water about (1) 32 feet high, (2) 50 feet high, (3) 100 feet high, (4) 500 feet high.	X 42.1 C 46.5	6.2 13.6
15. The sea of air extends above the earth approximately (1) 1 mile, (2) 10 miles, (3) 100 miles, (4) 1000 miles.	X 26.3 C 30.9	5.6 6.0
16. The barometer is used to indicate (1) a change in weather, (2) the degree of temperature, (3) isothermal lines, (4) density of substance.	X 68.2 C 77.0	−3.4 5.4
17. Atmospheric pressure is automatically recorded by the (1) barograph, (2) phonograph, (3) metronome, (4) heliograph.	X 54.4 C 65.0	24.0 12.1
18. Lindbergh found that it took longer to get the Spirit of St. Louis into the air in Mexico City than in New York City because of (1) the heavy atmospheric pressure, (2) the poor Mexican gasoline, (3) the high altitude of Mexico City, (4) the December air in Mexico was cooler and heavier than the summer air in New York City.	X 20.0 C 24.7	−.4 .5
19. An industrial application of the principle of resistance to atmospheric pressure is illustrated by (1) the use of hard oils and greases in lubricating an automobile,	X 30.1 C 33.7	20.1 31.9

Question	Per cent Right Initial	Per cent Gain
(2) the pneumatic cups on the tread of an automobile tire, (3) the oil pump on an automobile engine, (4) the differential on an automobile.		
20. Our bodies are prevented from being crushed by the enormous pressure of the atmosphere by (1) the bones of our bodies, (2) the resistance of the skin, which envelops the body, to pressure, (3) the balance of internal and external pressure, (4) high blood pressure.	X 47.8 C 57.8	15.6 15.2
21. Compressed air is especially valuable in mining because (1) it is more powerful than electricity, (2) it is cleaner, (3) there is no danger from sparks or fire, (4) air power is more cheaply transmitted.	X 48.1 C 58.6	−5.5 −.7
22. The air brakes used on trains were invented by (1) Holley, (2) Westinghouse, (3) Galileo, (4) Firestone.	X 38.3 C 50.6	13.0 14.0
23. A riveting machine is driven by (1) steam, (2) electricity, (3) compressed air, (4) a steel spring.	X 51.6 C 62.2	40.0 36.3
24. Compressed air is essential in the manufacture of (1) bricks, (2) Bessemer steel, (3) pottery, (4) concrete.	X 50.3 C 58.8	15.4 21.0
25. The main difference between free air and compressed air is that compressed air (1) has a greater number of gas particles per unit volume, (2) is colder than free air, (3) is more easily stored than free air, (4) is lighter than an equal volume of free air.	X 42.8 C 53.6	11.6 9.4
26. A basketball bounces when dropped to the floor because of (1) air elasticity, (2) the rubber bladder, (3) gravity, (4) atmospheric pressure.	X 31.3 C 43.2	21.9 26.4
27. The engineer applies the brakes on a train (1) by starting the air pump on the engine, (2) by cutting off the air to the cars, (3) by turning steam into the pressure tank, (4) by turning on the air to the cars.	X 20.8 C 24.0	43.9 22.0
28. The air pressure maintained by a locomotive is approximately (1) 10 pounds per square inch, (2) 40 pounds per square inch, (3) 80 pounds per square inch, (4) 100 pounds per square inch.	X 20.3 C 22.1	−7.6 −8.6
29. A sand blast is used to (1) polish marble, (2) drive a ventilating fan, (3) clean the walls of a building, (4) carve stone.	X 35.4 C 35.1	42.0 16.5
30. Air is pumped into an automobile tire to (1) stretch the inner tube, (2) furnish an elastic cushion, (3) prevent skidding, (4) prevent punctures.	X 60.6 C 73.8	19.6 19.2
31. Low, heavy rain clouds are called (1) cirrus, (2) cumulus, (3) nimbus, (4) cirro-cumulus.	X 33.2 C 34.9	19.2 12.1

Question	Per cent Right Initial	Per cent Gain
32. When large raindrops freeze as they fall through alternate layers of warm and cold air, they form (1) sleet, (2) snow, (3) hail, (4) dew.	X 62.7 C 71.9	2.9 3.5
33. Water cycle is the term applied to (1) a wheel run by water power, (2) a river boat propelled by pedals, (3) the evaporation and condensation of water, (4) ocean currents caused by storms at sea.	X 38.1 C 45.0	40.1 41.6
34. The amount of water vapor in the air is called (1) absolute humidity, (2) temperature, (3) sedimentation, (4) vapor saturation.	X 25.1 C 40.9	4.3 1.7
35. The level of the water table of a district is (1) the average height of rain clouds in that district, (2) equal to the average level of the rivers in that district, (3) the same as the level of free ground water below the surface, (4) the determiner of artesian water pressure.	X 24.3 C 26.1	14.2 11.3
36. Clouds which are composed of light particles and float at high altitudes are called (1) cumulus, (2) nimbus, (3) cirrus, (4) stratus.	X 27.2 C 29.2	22.1 15.6
37. The surface of a lake or permanent pond is usually a continuation of the (1) water cycle, (2) water table, (3) weather conditions, (4) ocean level.	X 23.9 C 31.1	20.1 9.7
38. When water passes from liquid to vapor form, the process is called (1) condensation, (2) precipitation, (3) locomotion, (4) evaporation.	X 67.2 C 74.5	4.2 6.9
39. Winds play a useful part in the water cycle because they (1) help distribute moisture over the earth, (2) set up currents in the ocean, (3) warm the air, (4) always blow from damp to dry regions.	X 54.7 C 63.6	12.1 18.2
40. Caves are formed when underground water dissolves and carries away (1) sandstone, (2) slate, (3) limestone, (4) lava.	X 27.7 C 37.4	14.6 16.3
41. The Ashokan Reservoir holds enough water to supply New York City for (1) one year, (2) three months, (3) one week, (4) three days.	X 30.3 C 31.9	16.8 34.3
42. New York City's water supply is brought to the city by (1) lift pumps, (2) suction pumps, (3) gravity, (4) stand pipes.	X 14.2 C 17.8	21.7 22.1
43. The channels through which water is carried are sometimes called (1) conduits, (2) conductors, (3) conveyors.	X 34.8 C 42.7	.4 7.2
44. The amount of water which New York City uses daily is about (1) 6 million gallons, (2) 60 million	X 24.4 C 25.7	−2.2 5.1

Question		Per cent Right Initial	Per cent Gain
	gallons, (3) 600 million gallons, (4) 6000 million gallons.		
45.	The altitude of the Ashokan Reservoir is about (1) 100 feet, (2) 600 feet, (3) 1000 feet, (4) 6000 feet.	X 30.3 C 32.2	3.1 4.0
46.	The reservoir in the New York water supply system which is the greatest distance from New York is called the (1) Ashokan, (2) Hill View, (3) Kensico, (4) Schoharie.	X 26.3 C 32.9	21.3 15.4
47.	The area of New York City's Catskill watersheds is about (1) 10 square miles, (2) 100 square miles, (3) 600 square miles, (4) 1000 square miles.	X 28.2 C 25.8	2.6 10.2
48.	The number of people who use New York City's water supply daily is about (1) 2 million, (2) 4 million, (3) 6 million, (4) 8 million.	X C	
49.	The construction of a water supply system for a city like New York requires the most skillful (1) doctors, (2) chemists, (3) engineers, (4) bacteriologists.	X 42.5 C 51.0	2.2 9.8
50.	The principal process used in treating New York City's water supply from the Catskill Mountains is (1) aëration, (2) distillation, (3) filtration, (4) chemical treatment.	X 8.5 C 10.5	36.7 37.9
51.	An excellent artificial water filter is (1) sand, (2) clay, (3) shale, (4) limestone.	X 64.2 C 81.8	18.5 11.2
52.	Mixing air with water is called (1) filtration, (2) chemical analysis, (3) aëration, (4) sedimentation.	X 40.9 C 53.8	34.3 32.5
53.	Sand filters are used in a water plant (1) to kill all of the bacteria, (2) to remove suspended matter, (3) to remove dissolved minerals, (4) to soften water.	X 35.5 C 45.5	23.3 24.9
54.	Freshly boiled water tastes bad because (1) the air has been driven out, (2) the bacteria have been killed, (3) gas from the fuel is absorbed, (4) odors are absorbed in boiling.	X 43.0 C 58.0	22.0 21.0
55.	A chemical which is used to coagulate the sediment in water is (1) aluminum sulphate, (2) chlorine, (3) sodium chloride, (4) iodine.	X 13.6 C 14.0	44.0 11.2
56.	Sand filters are sometimes cleaned by (1) pouring chemicals into the sand, (2) "back washing" the sand with clean water, (3) exposing the sand to sunlight, (4) stirring the sand after it has been allowed to dry.	X 32.7 C 38.1	41.1 33.9
57.	An acre of sand filtering surface will purify daily from (1) 10 to 15 thousand gallons of water, (2) 100 to 500 thousand gallons of water, (3) 2 to 5 million gallons of water, (4) over 15 million gallons of water.		

Question		Per cent Right Initial	Per cent Gain
58. A chemical frequently used to kill bacteria in water is (1) aluminum sulphate, (2) chlorine, (3) sodium chloride, (4) iodine.	X C	40.7 53.2	27.9 20.8
59. Water should be tested daily because (1) different examiners may find different conditions, (2) bacteria develop so rapidly that constant care must be taken to avoid danger.	X C	71.0 80.8	14.4 13.8
60. The intake tunnel in a city system getting water from a lake should extend out into deep water, because (1) the water is cooler, (2) the deep water does not need to be purified, (3) there are fewer bacteria and less sediment in the deep water than in water near the shore, (4) the tunnel is less likely to be damaged by boats.	X C	64.9 79.0	11.5 7.6
61. Limestone is one of the materials used in making (1) tar, (2) gasoline, (3) glass, (4) cork.	X C	61.2 68.1	27.4 22.1
62. The largest supply of marble in the United States comes from (1) Ohio, (2) Montana, (3) Vermont, (4) Alabama.	X C	53.3 62.9	18.9 24.9
63. A widely used limestone found in the United States is (1) Carrara, (2) Bedford, (3) Onyx, (4) Portland.	X C	20.0 23.8	60.0 69.4
64. A machine used in quarrying marble is the (1) channeling machine, (2) sand-blast machine, (3) pivot, (4) shearer.	X C	26.0 27.5	20.4 32.4
65. We know that limestone deposits were once under water, because (1) limestone is made up of the shells of tiny sea animals, (2) there is a large percentage of water in limestone, (3) there are water marks on limestone, (4) the earth was once larger than it is now.	X C	53.0 60.8	32.0 34.3
66. The grain in marble is brought out by (1) cutting, (2) polishing, (3) burning, (4) carving.	X C	40.7 54.3	26.9 22.1
67. Portland cement was first made by (1) an Englishman, (2) an American, (3) a German, (4) a Frenchman.			
68. In making lime, limestone is generally burned in (1) stones, (2) kilns, (3) fireplaces, (4) blast furnaces.	X C	34.9 40.2	42.3 47.8
69. A material mixed with iron ore in the blast furnace is (1) glass, (2) salt, (3) Portland cement, (4) limestone.	X C	63.6 73.6	2.5 .4
70. The material which is mixed with Portland cement to make concrete is (1) limestone, (2) coke, (3) sand, (4) potash.	X C	42.8 53.1	6.4 9.1

Question		Per cent Right Initial	Per cent Gain
71. In the brick plant clay is mixed with water and is kneaded in the (1) kiln, (2) pugmill, (3) potter's wheel, (4) sagger.	X	23.5	16.1
	C	25.2	9.7
72. The length of time required to burn bricks is about (1) 24 hours, (2) 2 days, (3) 15 days, (4) 21 days.			
73. A grindstone can sharpen steel tools because (1) there are quartz particles in the stone, (2) the stone is tougher than steel, (3) there is feldspar in the stone, (4) the grindstone can be turned very rapidly.	X	35.0	16.5
	C	43.0	6.9
74. Clay is placed on the potter's wheel for (1) kneading, (2) molding, (3) glazing, (4) polishing.			
75. Slate is prepared for the market by (1) grinding, (2) burning, (3) splitting, (4) glazing.	X	25.6	28.8
	C	29.3	27.9
76. Feldspar is found in (1) granite, (2) sandstone, (3) chalk, (4) marble.	X	30.3	35.8
	C	32.6	41.4
77. Quartz is found in (1) sandstone, (2) clay, (3) shale, (4) limestone.	X	33.6	23.1
	C	42.1	15.9
78. Sandstone building blocks are made into uniform size for the market by (1) molding, (2) sawing, (3) chiseling, (4) blasting.	X	10.0	25.4
	C	12.8	18.4
79. The ingredient in sand which is needed in the manufacture of glass is (1) iron ore, (2) silica, (3) arsenic, (4) potash.	X	39.0	−7.0
	C	41.6	18.3
80. The property of clay which makes it so valuable in making pottery is its (1) color, (2) low fusion point, (3) plasticity, (4) electrical conductivity.	X	57.7	12.7
	C	66.0	5.6
81. Seedlings are usually transplanted when they are about (1) 1 year old, (2) 5 years old, (3) 6 years old, (4) 10 years old.	X	60.4	17.5
	C	72.0	9.7
82. The average cost per thousand of seedlings is about (1) \$2, (2) \$10, (3) \$25, (4) \$100.	X	13.6	29.7
	C	15.1	33.8
83. Norway spruce is largely used for making (1) railroad ties, (2) telephone poles, (3) wood pulp, (4) box cars.	X	28.2	−5.3
	C	31.0	1.0
84. The average height of transplants used in reforesting large areas is about (1) 1 foot, (2) 2 feet, (3) 3 feet, (4) 4 feet.	X	15.5	25.9
	C	13.5	8.0
85. The cost per acre of planting seedlings when paid labor is used averages about (1) \$5, (2) \$10, (3) \$20, (4) \$50.	X	22.9	15.1
	C	23.7	14.4
86. White pine grows best in (1) very sandy soil, (2) soil that has much loam in it, (3) hard red clay, (4) swampy soil.	X	53.0	1.9
	C	60.8	−4.8

Question	Per cent Right Initial	Per cent Gain
87. The main reason why forests hold more water in the soil than grass and weeds is: (1) the shade of the trees prevents evaporation, (2) the mulch formed by fallen leaves absorbs and holds much of the rain water, (3) the deep roots of large trees draw the water into the soil, (4) the rain hits the ground with less force, since it strikes the leaves and limbs on the trees before it reaches the soil.	X 22.5 C 26.4	12.0 23.0
88. One of the conditions that makes reforestation a good school project is that setting out seedlings (1) requires great care and technical skill, (2) requires much hand work that can be done efficiently by many working together, (3) transplanting an acre should be spread out over several weeks of time to secure the best results, (4) can be done on national holidays.		
89. A forested watershed is better than a deforested one as the source for a city water system, because (1) more rain falls on forested than on denuded hills, (2) the decaying leaves on the forest floor filter the water and make it flow into the reservoirs more slowly and steadily, (3) water from forested areas contains more mineral salts and is therefore more healthful, (4) water from forested areas is cooler than water from denuded water sheds.	X 32.7 C 36.1	22.7 34.4
90. Careless timber cutting has increased the fire hazard to our forests by (1) completely denuding large areas of all timber and wood, (2) cutting the trees too near the ground, (3) cutting only the largest trees, (4) leaving the tops and branches of cut trees lying wherever they fell amongst the uncut trees.	X 61.0 C 73.2	21.4 19.1
91. The tent caterpillar is most harmful to trees when it is in the life stage called (1) pupa, (2) egg, (3) larva, (4) adult.	X 27.3 C 35.5	24.9 33.1
92. The water which a tree gets from its roots goes up to the leaves through that part of the tree called the (1) bark, (2) core, (3) sapwood, (4) root hairs.	X 22.3 C 25.1	2.0 7.5
93. In transplanting trees it is most important to protect the (1) leaves, (2) branches, (3) buds, (4) roots.	X 86.0 C 92.4	2.5 4.7
94. One favorable season for transplanting trees is in the (1) late fall, (2) winter, (3) summer, (4) late spring.		
95. Damage to the fruit and foliage of large trees in the United States is mostly caused by (1) birds, (2) large animals, (3) insects, (4) tree frogs.	X 83.1 C 90.6	8.4 7.9

Question	Per cent Right Initial	Per cent Gain
96. In transplanting trees guy wires are most often used (1) to distribute the water supply more evenly, (2) to prevent loosening of the roots, (3) to strengthen the side branches, (4) to make the tree grow straight up.		
97. In transplanting trees the main purpose of cutting off some of the branches is (1) to make the tree grow tall, (2) to reduce the evaporating surface of the foliage, (3) to reduce the shade, (4) to make the trees more beautiful.	X 34.2 C 40.5	5.9 7.3
98. In its second life stage, the tent caterpillar is called (1) egg, (2) pupa, (3) larva, (4) adult.	X 45.9 C 48.8	−3.4 −6.9
99. The early spring is a favorable season for transplanting trees, because (1) the leaves have just fallen, (2) the winter buds have formed, (3) the trees are flowering, (4) the spring buds have not yet opened.	X 55.4 C 65.0	8.0 12.2
100. A spray commonly used to destroy insects harmful to trees contains (1) chlorine, (2) lysol, (3) baking soda, (4) Paris green.	X 30.3 C 35.0	24.0 33.8

GENERAL SCIENCE
TEST C3

PER CENTS OF CORRECT ANSWERS ON EACH QUESTION

(Given only at the end of the experiment. Per cents of correct answers are based on returns from five of the twelve cities, the tabulations of answers for the remaining cities not being available in timr for inclusion in this report.)

Topic	Questions	Five Cities Per cent Correct Answers X	C
Hot Air Heating			
	1. Radiant energy from a fire (passes through — is stopped by) a metal screen placed before the fire.	45	46
	2. A metal screen placed before a fire becomes (as hot as — hotter than) the air between it and the fire.	65	52
	3. Cold air flows (towards — away from) an open fire.	82	76
	4. The jacket about a stove usually (extends — does not extend) to the floor.	65	72
	5. A jacket about a stove is usually (open — closed) at the top.	86	78

Topic	Questions	Five Cities Per cent Correct Answers X	C
	6. The jacket about a heating furnace is (always — not always) cylindrical in form.	53	48
	7. The pipes from a heating furnace carry hot air to the rooms of the house (from the fire box — from the jacket about the fire box).	46	64
	8. When a large building is heated by a hot air furnace the amount of fire in the fire box is (controlled — not controlled) from each room independently.	45	47
	9. Moisture is added to the air heated by a furnace (before — after) the air leaves the furnace.	72	67
	10. The outlet for air from a room heated by a hot air furnace should be (near the floor — near the ceiling).	62	50
	Average for topic	62	60
Atmospheric Pressure			
	1. Air (rushes — does not rush) in at the back of a revolving fan.	84	69
	2. The dirt is (drawn — pushed) into a vacuum cleaner.	88	79
	3. Dirt is carried into a vacuum cleaner by (a revolving brush — a current of air).	79	82
	4. (Mercury — water) tends to rise about thirty inches in a vacuum tube.	83	84
	5. When water is changed to steam in an open can and the can is then closed and cooled the air pressure in the can is (reduced — increased).	78	62
	6. When the air is removed from a pair of Magdeburg hemispheres, atmospheric pressure holds them together with a force (greater — less) than the pulling power of two horses.	96	93
	7. When a barograph is taken from a valley to a hill top it registers (an increased — a decreased) atmospheric pressure.	61	59
	8. Warm air moves (upwards — sidewise) from an open campfire.	75	65
	9. At night air tends to blow from (land to sea — sea to land).	53	74
	10. When the handle of a water pump is pushed down, the valve in the plunger (opens — closes).	68	63
	11. The wind tends to blow from (cooler to warmer — warmer to cooler) areas.	65	61
	Average for topic	75	72
Compressed Air			
	1. The pressure of (water — air) in the drum of a fire engine produces a steady flow of water from the fire hose.	91	73

Topic	Questions	Five Cities Per cent Correct Answers X	C
	2. In steel construction work (hot — cold) rivets are used.	94	88
	3. In steel construction work rivets are (carried — thrown) to the man who places them for the riveter.	93	54
	4. The stone cutter moves a compressed air chisel about (by hand — with tongs).	82	69
	5. The railroad engineer sets the air brakes (by turning on — by shutting off) the air.	79	50
	6. The brakes on a train are (held away from — pressed against) the wheels by compressed air.	25	19
	7. The bellows of a blacksmith's forge (draws — drives) air through the fire.	69	71
	8. Compressed air is driven into a Bessemer converter at the (top — bottom).	60	62
	Average for topic	69	61
The Water Cycle			
	1. Clouds of vapor rising from a stream (finally disappear into the air — continue to grow larger and denser) as they rise.	54	65
	2. The amount of evaporation from a body of water is affected by (the area of water surface exposed — the depth of the water).	78	82
	3. A cloud of vapor from the escaping steam of a locomotive resembles a (cirrus — cumulus) cloud.	63	48
	4. Winds distribute moisture over the earth by driving (clouds — rain) from place to place.	76	76
	5. The level of the water table below the surface of a hill is (higher — lower) than the level of the water table below a valley.	65	65
	6. Underground water (may — never does) wash out holes in the earth.	90	92
	7. (Part — no part) of the water cycle takes place in the leaves of plants.	87	86
	8. The water table is (always above — sometimes below) the bed of a permanent lake.	41	32
	Average for topic	69	68
New York Water Supply			
	1. The skyscrapers of New York (can be seen — cannot be seen) from the Statue of Liberty.	96	96
	2. There is (more — less) water in the Catskill Mountains than there is in and around New York City.	45	42
	3. The mountain tops in the Catskills are usually (rounded — sharp-peaked).	65	60

Topic	Questions	Five Cities Per cent Correct Answers X	C
	4. Water from the most distant reservoir starts its flow to New York (as a surface stream — through a tunnel).	63	66
	5. Water for New York City flows (all the way from the Catskills in a cement conduit — part of the way through the channel of an open stream).	88	48
	6. Water is aërated by (blowing air through it — forcing it through spray fountains).	90	80
	7. Where the water supply for New York City passes from the west to the east side of the Hudson River the banks are (high — low).	68	60
	8. The water supply for New York City is carried (over — under) the Hudson River.	93	90
	Average for topic	76	68
Purifying Water			
	1. When sediments settle from a beaker of muddy water the (larger — heavier) particles settle first.	88	88
	2. A settling basin is usually (deep — shallow).	54	61
	3. Mud is (washed — scraped) from the bottom of a settling basin.	52	62
	4. In a sand and gravel filter the fine material is at the (top — bottom).	74	65
	5. Filters are cleaned (by means of a vacuum cleaner — by reversing the flow of water through them).	96	95
	6. A farm well should be so (located — lined) that seepage from the barnyard cannot get into it.	86	86
	7. Bacteria are destroyed in a city water system by (boiling the water — chemicals).	94	92
	8. Water should be tested daily for (sediment — bacteria).	97	97
	9. Water is tested in shallow dishes, placed in an incubator to (kill — grow) the bacteria in it.	72	55
	Average for topic	79	78
Limestone and Marble			
	1. A (steam hammer — rotary grinder) is used to crush limestone for road building.	71	71
	2. Chalk is formed from (shells — powdered limestone).	76	59
	3. When large blocks of limestone are quarried, they are (blasted — split) from the bed rock of the quarry.	59	50
	4. Limestone is cut to size by (splitting — sawing).	75	60
	5. In a large stone-cutting and planing mill, cylindrical limestone columns are (chiseled out by hand — turned out on a lathe).	78	70

Topic	Questions	Five Cities Per cent Correct Answers X	C
	6. In planing a piece of limestone the (stone — chisel) moves back and forth.	44	35
	7. In building the stone wall for a large building, the stone and mortar are (always — not always) carried up to workmen on separate ropes.	50	50
	8. At a modern lime kiln the limestone is put into the kiln through an opening in the (top — side).	67	62
	9. Cement is burned in a (rotary — shaker) kiln.	84	79
	10. Marble is polished by means of (a sand blast — rotary pads polisher).	85	59
	Average for topic	69	60
Sand and Clay			
	1. The machine for making artificial sandstone blocks pushes the blocks out through the (top — bottom) of the mold.	62	34
	2. Large blocks of sandstone are (blasted — split) from the bedrock of the quarry.	54	48
	3. Grindstones are made round by (cutting with a saw — turning on a lathe).	86	77
	4. In making plate glass the material is (melted in crucibles — poured into crucibles after melting).	62	56
	5. Plate glass is made by (rolling the molten glass into sheets on a table — pouring the molten glass into molds).	93	83
	6. Slate is (cut — split) into sheets.	91	73
	7. Bricks are molded by (pressing — pouring) clay into a mold.	81	73
	8. In a large drying yard bricks are usually turned (one — several) at a time.	84	85
	9. When the potter himself turns his wheel he turns it with his (hand — foot).	79	80
	10. Pottery is glazed by (dipping — spraying) and heating.	92	58
	Average for topic	78	67
Reforestation			
	1. Nursery tree seedlings for planting in a reforestation project are taken from (hot house beds — open air beds).	91	72
	2. Tree seedlings for reforestation are (more — less) than two feet tall.	81	53
	3. Tree seedlings are crated for shipping (with — without) soil packed about the roots.	57	18
	4. In reforesting a large area with tree seedlings the holes are usually dug with a (spade — a hoe-like implement).	82	61

Topic	Questions	Five Cities Per cent Correct Answers X	C
	5. In a large reforestation project the distance apart that tree seedlings are to be planted is (measured with a tape line — stepped off).	95	62
	6. The depth at which a tree seedling should be planted is (shown — not shown) by a mark on the seedling.	81	59
	7. Tree seedlings that have been shipped from a nursery are (banked up with soil — kept wrapped in damp cloth) until wanted for planting.	85	60
	8. In planting a tree seedling the soil is packed (loosely — tightly) about the roots.	82	66
	Average for topic	82	56
Planting and Care of Trees			
	1. The caterpillar of the tussock moth is (woolly — tufted).	45	44
	2. Codling moths develop (on the leaves — in the fruit) of the apple tree.	39	47
	3. Tent caterpillars eat the (leaves — fruit) of a tree.	86	75
	4. A tree from the nursery is trimmed (before — after) it has been dug up for transplanting.	84	47
	5. Nursery trees for transplanting are usually (more — less) than two feet tall.	32	43
	6. Grafting (leaves — does not leave) a scar on the grafted tree.	75	74
	7. In transplanting a tree, the forester (trims — does not trim) closely.	83	68
	8. In transplanting a tree, the forester (trims — does not trim) the roots closely.	64	76
	9. In transplanting a tree, the roots are (pressed together — spread out) in the hole.	93	94
	10. When a tree is transplanted, it is usually held straight by (wooden props — guy ropes).	94	87
	Average for topic	68	64

APPENDIX III

THE COMPREHENSIVE TESTS IN GEOGRAPHY

(Test C1 is omitted for the reason given on page 283.)

TEST C2

(Given at beginning and end of experiment.)

INITIAL PER CENT OF CORRECT ANSWERS AND PER CENT OF GAIN FOR EACH QUESTION, TAKING ALL TWELVE CITIES TOGETHER

Topic	Questions		Per cent Right Initial	Per cent Gain
New England Fisheries, Part I — Cod				
1.	The boat used in cod fishing is called a (1) freighter, (2) yacht, (3) steamer, (4) schooner.	X C	82.4 85.5	15.4 12.3
2.	The average weight of cod fish is about (1) 2 pounds, (2) 15 pounds, (3) 50 pounds, (4) 100 pounds.	X C	36.8 38.0	−11.7 −1.3
3.	An important product obtained from the liver of the cod fish is (1) bait, (2) oil, (3) fertilizer, (4) fuel.	X C	79.0 78.0	1.6 6.8
4.	In the United States the number of men engaged in fishing of all kinds is about (1) 5000, (2) 50,000, (3) 200,000, (4) 1,000,000.	X C	24.2 23.8	6.2 8.3
5.	The cod fisherman baits his hooks with (1) fish, (2) worms, (3) frogs, (4) mechanical flies.	X C	22.7 27.9	61.1 41.8
6.	One of the ways in which cod fish is prepared for market is (1) drying, (2) boiling in oil, (3) grinding, (4) smoking.	X C	53.4 54.0	30.6 21.2
7.	New England is noted for (1) coal mining, (2) ship-building, (3) cattle raising, (4) iron smelting.	X C	33.2 38.4	47.8 30.0
8.	Cod fish are cleaned and salted (1) at the dock, (2) on the schooner, (3) in the dory, (4) in the packing house.	X C	24.6 34.2	29.0 36.4
9.	One of the most noted fishing centers in the United States is (1) New York, (2) Gloucester, (3) Jamestown, (4) Savannah.	X C	42.7 50.3	51.7 40.9
10.	The small boats which fishermen use in taking the cod fish off the trawl lines are called (1) canoes, (2) rafts, (3) tugs, (4) dories.	X C	45.1 52.4	49.9 43.0

Topic	Questions	Per cent Right Initial	Per cent Gain
Wisconsin Dairies			
11.	Ensilage is made from (1) oats, (2) wheat, (3) green corn stalks, (4) dry ears of corn.	X 35.5 C 36.4	41.3 32.4
12.	The State which ranks first in dairying is (1) New York, (2) Wisconsin, (3) Illinois, (4) Ohio.	X 49.9 C 55.5	44.9 37.7
13.	In order to kill harmful bacteria milk is (1) cooled, (2) separated, (3) pasteurized, (4) bottled.	X 61.8 C 60.1	26.0 18.7
14.	The part of the barn in which ensilage is kept is called (1) bin, (2) crib, (3) haymow, (4) silo.	X 40.8 C 43.1	49.6 43.9
15.	The cows which produce the greatest amount of milk are (1) Jerseys, (2) Holsteins, (3) Herefords, (4) Durhams.	X 21.4 C 18.6	35.2 27.5
16.	Milk is strained in order to (1) remove bacteria, (2) remove dirt and foreign particles, (3) separate the cream, (4) mix the milk and make it of uniform quality.	X 49.8 C 50.2	28.2 19.9
17.	Milking machines are used because (1) they reduce labor and are more sanitary, (2) they are easier on the cows, (3) they are popular with farmers, (4) they do not milk the cows dry.	X 66.8 C 67.5	15.4 14.7
18.	Milk is cooled as soon as it is taken from the cows in order to (1) kill all the bacteria in the milk, (2) retard the growth of harmful bacteria, (3) make the milk taste better for immediate use, (4) keep the cream from rising.	X 13.8 C 15.4	11.2 13.5
19.	Good roads are necessary in a dairy region in order to (1) get the milk from the dairy farms to market quickly, (2) give the farmers more time for other things, (3) promote the use of pleasure cars, (4) encourage the tourist trade.	X 68.2 C 71.2	15.2 9.6
20.	Dairying is one of the greatest industries in the world because (1) milk is one of the most important foods man uses, (2) it pays better than most industries, (3) it attracts city dwellers to the country, (4) it encourages the breeding of better cattle.	X 86.4 C 88.4	6.6 4.9
Wheat			
21.	The average yield per acre of wheat in the United States is about (1) 15 bushels, (2) 30 bushels, (3) 50 bushels, (4) 80 bushels.	X 6.6 C 7.8	3.1 2.0
22.	Great care must be taken to cut wheat at the right time, because if it becomes too ripe (1) many of the grains will be scattered and lost, (2) fungus growths	X 33.1 C 31.8	19.9 22.0

Topic	Questions	Per cent Right Initial	Per cent Gain
	called rust will destroy it, (3) the grain will not keep well, (4) the little seed plant called the embryo will be killed.		
	23. A city noted for its great flour mills is (1) Los Angeles, (2) Denver, (3) Minneapolis, (4) Pittsburgh.	X 51.5 C 53.6	20.6 23.4
	24. The reaper was invented by (1) Ford, (2) Edison, (3) Westinghouse, (4) McCormick.	X 42.7 C 39.0	24.1 27.6
	25. The large fireproof buildings in which wheat is stored for shipment are called (1) bins, (2) barns, (3) silos, (4) elevators.	X 45.5 C 45.9	32.9 33.5
	26. The machine which cuts the wheat and ties it into bundles is called (1) the drill, (2) the flail, (3) the binder, (4) the threshing machine.	X 41.5 C 39.3	31.0 30.7
	27. Spring wheat is raised in regions which have (1) heavy rainfall throughout the growing season, (2) little rainfall in the spring and hot summer weather, (3) cool summers and cold winter weather, (4) heavy spring and fall rainfall.	X 25.8 C 24.9	16.9 15.2
	28. In dry farming, moisture is retained in the soil by (1) packing the surface soil, (2) keeping the surface soil in a dry, porous condition, (3) plowing the soil very deeply, (4) planting crops which do not use moisture.	X 16.4 C 16.0	−1.7 −1.6
	29. In wheat farming, after the ground has been plowed and harrowed, the drill is used to (1) break up the clods, (2) kill the weeds, (3) plant the seeds, (4) cultivate the crop.	X 30.9 C 29.6	−3.2 −.8
	30. The substance in the grain of wheat which is largely responsible for the light bread which can be made from wheat flour is (1) starch, (2) oil, (3) gluten, (4) bran.	X 10.2 C 9.6	3.1 13.1
From Wheat to Bread			
	31. In a large modern flour mill the wheat is carried from the cleaners to the grinders by (1) gravity, (2) endless conveyor, (3) scoops, (4) small electric cars.	X 29.8 C 30.2	35.6 24.9
	32. The ground wheat is carried from the grinders to the sifter by (1) gravity, (2) endless conveyor, (3) mechanical scoops, (4) hand-operated shovels.	X 11.2 C 10.8	.4 1.9
	33 The flour that is ground finely enough for use goes from the sifters to (1) the weighing machines, (2)	X 7.9 C 7.1	7.9 3.5

Topic	Questions	Per cent Right Initial	Per cent Gain
	the conditioners, (3) the storage bins, (4) the drying ovens.		
	34. Large modern flour mills can produce flour of a uniform grade because (1) the new mills use automatic machinery throughout the whole process of milling, (2) large-scale production makes possible mixing wheat from many widely separated farms. (3) the grinders are made of steel instead of stone, (4) their power source is more regular.	X 13.7 C 13.4	−1.0 −.8
	35. In a modern bakery the dough is kneaded by (1) rotating slats, (2) hand, (3) iron drums, (4) wheels covered with rubber.	X 28.2 C 27.3	6.4 3.0
	36. In a modern bakery portions of the large mass of dough are cut and put into the proper shape for the pans (1) by workers wearing sanitary rubber gloves, (2) by automatic machinery, (3) by a combination of machine and hand work, (4) by bare-handed laborers working in pairs.	X 19.5 C 17.6	−6.6 −5.5
	37. After being panned, the loaves of bread are carried into the oven by (1) workers using flat trays with long handles, (2) an endless conveyor, (3) narrow shelves on a revolving cylinder.	X 22.4 C 22.1	14.6 −3.6
	38. Modern bakeries make bread under conditions which are more sanitary than in the average home kitchen, because (1) the workers wear rubber gloves, (2) production is on a large scale and much automatic machinery is used, (3) the loaves of bread are more uniform in size, weight, and shape, (4) large bakeries are usually located in large cities.	X 36.6 C 37.1	15.2 15.3
	39. One of the advantages of large modern bakeries is that (1) fresh bread of uniform weight and standard quality is available to large numbers of people, (2) bakery bread is wrapped so that it can be kept indefinitely and shipped long distances, (3) bakery bread loaves can be made larger, (4) the crust on bakery bread is more uniform.	X 30.5 C 28.6	13.2 10.2
	40. At the flour mill wheat is unloaded from the railroad box cars by means of (1) endless conveyors, (2) scoops, (3) gravity chutes, (4) electric cranes.	X 21.6 C 20.1	18.5 4.6
Cattle			
	41. The cattle of different owners on the open range are identified by their (1) color, (2) age, (3) size, (4) brand.	X 82.8 C 84.2	11.6 11.1

Topic	Questions	Per cent Right Initial	Per cent Gain
42.	Cattle that are shipped to the packing houses are loaded on to railroad cars by means of (1) elevators, (2) inclined planes, (3) steel cranes, (4) sleds.	X 28.7 C 27.1	29.1 24.5
43.	The food most frequently given to range cattle in winter is (1) timothy, (2) ensilage, (3) wheat straw, (4) alfalfa.	X 41.6 C 43.7	31.4 27.3
44.	When cattle are old enough, but not fat enough for the market, they are shipped for "finishing" to (1) the cotton belt, (2) the grassy plains of Mexico, (3) the corn belt, (4) the spring wheat belt.	X 26.6 C 26.9	36.5 42.3
45.	The principal purpose of "dipping" cattle is to (1) get them washed for the market, (2) remove ticks and prevent fever, (3) keep them from getting overheated in summer, (4) keep their hoofs from becoming too brittle.	X 53.3 C 57.3	36.0 29.9
46.	The disinfectant used to prevent cattle fever on Western cattle ranches is applied (1) with a brush, (2) by spraying, (3) with buckets, (4) by driving the cattle through vats containing disinfecting liquid.	X 47.4 C 45.9	38.4 30.1
47.	Most of the cattle raised in the United States for the beef market are (1) Texas Longhorns, (2) Shorthorns, (3) Holsteins, (4) Jerseys.	X 20.3 C 18.8	14.0 18.2
48.	Alfalfa for use on Western cattle ranches is cut by means of (1) mowers, (2) long knives, (3) hoes, (4) large clippers.	X 47.7 C 49.5	28.2 21.6
49.	On long trips cattle are usually unloaded from railroad cars for rest every (1) 6 hours, (2) 12 hours, (3) 28 hours, (4) 3 days.	X 19.8 C 19.5	10.9 8.9
50.	The "bull pen" at a rodeo is the place where are kept (1) the wild animals, (2) the racing ponies, (3) the cattle for the beef market.	X 15.5 C 15.3	41.4 34.0
Corn			
51.	Most of the corn produced in the United States is used (1) to make corn starch, (2) to manufacture breakfast foods such as cornflakes, post toasties, etc., (3) to make corn meal, (4) as a food for live stock (horses, dairy cows, hogs, etc.).	X 38.3 C 37.6	25.2 21.7
52.	One of the purposes of cultivating growing corn is (1) to reduce the evaporation of soil water, (2) to smooth the ground for the harvesters, (3) to make the grains of corn harder, (4) to make several stalks grow in each hill of corn.	X 23.3 C 4.0	20.4 35.2

Topic	Questions	Per cent Right Initial	Per cent Gain
53.	One of the greatest corn-producing States in the United States is (1) Illinois, (2) Texas, (3) Kentucky, (4) New York.	X 41.5 C 44.7	21.7 18.6
54.	The main purpose of harrowing corn land is (1) to destroy weeds, (2) to pulverize the soil and prepare it for seeding, (3) to increase evaporation of soil water, (4) to put fertilizer deep in the soil.	X 27.6 C 27.0	19.4 20.0
55.	One of the insects which cause great damage to corn in the United States is (1) the corn fly, (2) the corn borer, (3) the caterpillar, (4) the red wasp.	X 58.8 C 63.2	34.9 27.9
56.	Corn was first grown in America by (1) native Indians, (2) Spanish settlers that came over with Columbus, (3) English colonists, (4) Dutch colonists.	X 82.1 C 83.7	8.2 9.1
57.	The chief purpose of rotating crops in the corn belt is to (1) secure a variety of food for live stock, (2) prevent an oversupply of corn, (3) prevent exhaustion of the soil, (4) make the corn ripen early in the season.	X 18.7 C 21.0	19.6 17.9
58.	Before it is put into the silo corn is (1) shelled, (2) chopped, (3) dried, (4) sifted.	X 16.8 C 16.5	38.4 30.8
59.	More than half of the corn annually produced in the world is grown in (1) Europe, (2) United States, (3) Russia, (4) South America.	X 57.3 C 74.2	10.7 13.6
60.	Corn that is to be used for seed is usually (1) kept in the silo during the winter, (2) carefully selected, (3) polished, (4) harvested before it is fully ripe.	X 21.5 C 19.2	38.0 38.9
Cotton			
61.	The greatest enemy of cotton is (1) rust, (2) man, (3) cutworm, (4) boll weevil.	X 58.1 C 58.3	37.9 36.9
62.	The country which imports the largest amount of cotton from the United States is (1) Great Britain, (2) Norway, (3) Germany, (4) France.	X 41.4 C 39.0	9.4 12.0
63.	The most favorable weather conditions for raising cotton are (1) plenty of rainfall throughout the growing season, (2) plenty of rainfall in the spring and light rainfall in the summer and autumn, (3) heavy rainfall in the early fall and winter, (4) continuous cloudy weather for the last half of the growing season.	X 44.0 C 43.3	9.6 9.8
64.	The length of time required for cotton to mature after planting is about (1) one month, (2) three months, (3) six months, (4) ten months.	X 39.3 C 37.6	−1.2 3.0

Topic	Questions	Per cent Right Initial	Per cent Gain
65.	The States in which cotton is grown are sometimes called (1) the Border States, (2) the Cotton Belt, (3) the Piedmont regions, (4) the Sunset Empire.	X 85.8 C 85.1	6.6 5.9
66.	The seeds are removed from cotton by (1) threshing, (2) picking, (3) baling, (4) ginning.	X 57.9 C 55.1	24.5 26.3
67.	Cotton is graded according to (1) length, (2) size of bolls, (3) weight of seeds, (4) whiteness of the fiber.	X 26.9 C 26.8	26.1 29.0
68.	The cotton gin was invented by (1) Fulton, (2) Whitney, (3) Morse, (4) Bell.	X 67.8 C 67.3	18.4 19.7
69.	A bale of cotton weighs about (1) 100 pounds, (2) 500 pounds, (3) 1000 pounds, (4) 2000 pounds.	X 42.1 C 43.0	24.0 24.7
70.	The proportion of the world's annual cotton crop raised in the United States is about (1) one tenth, (2) one half, (3) three quarters, (4) nine tenths.	X 41.3 C 41.7	6.0 1.1
Irrigation			
71.	The name of a large dam in the United States which was built for irrigation purposes is (1) Roosevelt, (2) Gatun, (3) Boulder, (4) Kensico.	X 55.0 C 55.3	36.9 37.9
72.	The amount of water which a farmer uses for irrigation is regulated by (1) weir, (2) meter, (3) yardstick, (4) scales.	X 13.7 C 14.2	40.3 17.0
73.	Most of the water used for irrigation in the Imperial Valley is supplied by (1) Colorado River, (2) Rio Grande, (3) mountain lakes, (4) underground springs.	X 31.7 C 31.5	47.0 34.1
74.	One reason why such large crops can be grown on irrigated lands in the Southwest is (1) there are so many sunshiny days, (2) the weather is never too warm for comfort, (3) there is plenty of rainfall, (4) the rainfall occurs mostly in the growing season.	X 30.0 C 30.2	16.5 14.2
75.	The development of irrigation for desert lands is often called (1) conservation, (2) reforestation, (3) reclamation, (4) diversified farming.	X 16.4 C 15.3	7.3 13.2
76.	Irrigation is sometimes advantageous even in regions having a high average rainfall because it (1) makes plants grow rapidly, (2) prevents killing frosts, (3) tends to eliminate the danger arising from irregular rainfall, (4) prolongs the growing season.	X 20.6 C 20.4	10.6 12.7
77.	The size of the crops which can be raised on irrigated lands as compared with land having average rainfall is (1) half as large, (2) the same amount, (3) twice as large, (4) five times as large.	X 26.0 C 27.0	12.9 11.9

Topic	Questions	Per cent Right Initial	Per cent Gain
	78. Orchards are usually irrigated by (1) furrowing, (2) sprinkling, (3) flooding, (4) carrying water in buckets.	X 30.8 C 34.4	10.6 11.6
	79. The main use of a diversion dam for irrigation is to (1) dam up a supply of water, (2) enable farmers to take water from the side of a stream, (3) save ground water, (4) prevent floods.	X 15.6 C 20.7	13.5 7.0
	80. Farmers settle on irrigated areas mainly because (1) land is cheap, (2) they are near city markets, (3) farm work is easier, (4) they are fairly certain that the crops will not fail.	X 54.9 C 54.5	11.6 9.9
Bituminous Coal			
	81. Power for running machinery in the United States is largely supplied by (1) horses, (2) sunshine, (3) coal, (4) lightning.	X 75.0 C 76.1	9.9 10.1
	82. The chief fuel element in coal is called (1) carbon, (2) carbon dioxide, (3) coal tar, (4) illuminating gas.	X 13.5 C 13.0	4.2 7.6
	83. Bituminous coal is called (1) hard coal, (2) soft coal, (3) coke, (4) peat, (5) lignite.	X 34.8 C 40.1	37.4 34.9
	84. The opening into a bituminous coal mine is called the (1) shaft, (2) elevator, (3) pit, (4) arch.	X 39.4 C 36.3	36.4 35.3
	85. A city which is known as the center of a great coal area in the United States is (1) New York, (2) Boston, (3) Pittsburgh, (4) Kansas City.	X 65.1 C 68.2	27.0 21.0
	86. The beehive process of making coke is wasteful because (1) all gases escape, (2) the coal tar is burned, (3) less carbon is extracted, (4) the carbon is oxidized.	X 34.6 C 33.9	24.6 31.4
	87. The length of time required to make coke by the retort method is about (1) 12 hours, (2) 24 hours, (3) 36 hours, (4) 48 hours.	X 27.5 C 25.9	23.0 3.3
	88. More than half of the coal mined in the United States is used to (1) keep the people warm, (2) make illuminating gas, (3) generate steam to run machinery, (4) smelt iron.	X 23.6 C 25.2	22.4 2.9
	89. The State which ranks first in coal production is (1) Illinois, (2) Montana, (3) Indiana, (4) Pennsylvania.	X 60.2 C 69.9	18.9 14.6
	90. Water is poured on coke when it is first taken from the retort plant in order to (1) keep it from burning up, (2) give it moisture, (3) weather it, (4) make it soft.	X 34.6 C 34.6	34.6 17.5

Topic	Questions	Per cent Right Initial	Per cent Gain
Iron Ore to Pig Iron			
91.	Iron ore is smelted in (1) a beehive oven, (2) a blast furnace, (3) a retort plant, (4) an open hearth.	X 67.2 C 66.8	22.3 15.8
92.	The city from which most of the iron ore of the Mesaba district is shipped is (1) Gary, (2) Chicago, (3) Duluth, (4) Pittsburgh.	X 33.2 C 33.1	14.0 14.9
93.	The waste material which is drawn off the top of the molten iron in the blast furnace is called (1) coke, (2) limestone, (3) pig iron, (4) slag.	X 31.9 C 31.1	48.0 42.5
94.	The time usually required to load the iron ore boat at Duluth is about (1) 1 day, (2) 8 hours, (3) 2 hours, (4) 25 minutes.	X 10.0 C 9.9	42.5 38.1
95.	One of the materials that is put into the blast furnace with iron ore is (1) bituminous coal, (2) coke, (3) copper, (4) granite.	X 25.5 C 25.1	52.9 43.9
96.	Wherever possible iron ore is shipped by boat instead of by rail because (1) it is cheaper, (2) it is quicker, (3) the iron ore keeps better, (4) iron ore is too heavy for safe shipment in ordinary box cars.	X 39.4 C 32.9	22.8 15.1
97.	The main reason why iron ore is carried to Pittsburgh for smelting is (1) the mild climate of Pittsburgh, (2) Pittsburgh is the center of a great coal area, (3) Pittsburgh is a large city with a large labor population, (4) Pittsburgh has many large banks and financial magnates.	X 58.0 C 59.9	12.8 10.3
98.	The blast furnaces tend to be nearer to the pig iron market than to the Mesaba ore mines because (1) the people in Minnesota don't know how to smelt iron ore, (2) the mills were started before the mines were discovered, (3) it reduces transportation costs, (4) there are not enough laborers living near the mines.	X 24.5 C 27.5	10.0 8.2
99.	The highest water level in the Great Lakes is in (1) Lake Michigan, (2) Lake Erie, (3) Lake Ontario, (4) Lake Superior.	X 31.2 C 34.2	38.6 31.3
100.	The iron-ore boats are raised or lowered in the Sault Saint Marie Canal by means of (1) locks, (2) electric trains, (3) elevators, (4) tugboats.	X 42.8 C 44.1	45.4 39.2

GEOGRAPHY

TEST C3

(Given only at the end of the experiment.)

PER CENT OF CORRECT ANSWERS ON EACH QUESTION

Topic / Questions	Five Cities Per cent Correct Answers X	C
New England Fisheries — Cod		
1. In getting a schooner ready for a cod fishing trip:		
(1) Supplies are (piled on deck — stored below deck).	73	71
(2) Salt is (packed away in bags — run into the hold by a chute).	73	38
(3) The boat is (drawn up to the wharf — anchored in the bay).	57	49
2. On the way to the cod fishing banks dories are:		
(1) (Carried on deck of schooner — towed along by schooner.)	83	70
(2) (Lowered to water by machinery — pushed into water by hand.)	46	42
(3) Driven by (oars — sails).	64	61
3. Trawls are:		
(1) Set (by schooners — by dories).	68	81
(2) Tied to (poles — floats).	65	64
(3) Baited on the (schooner — dories).	74	38
4. In fishing for cod:		
(1) The fish are caught from (schooners — dories).	90	78
(2) The fish are pulled in by (hand — windlass).	77	62
(3) The hook is (jerked — cut) from the fish.	56	50
5. In preparing salt cod the bones are:		
(1) (Pulled — cut) out.	74	34
(2) Removed by (hand — machine).	84	66
(3) Removed (on the boat — at the place where the fish are dried).	79	45
Average for topic	71	52
Wisconsin Dairies		
1. In milking a cow by hand:		
(1) The cow is (tied — not tied) by a rope.	60	53
(2) The bucket is (set on the ground — held between the knees).	43	36
2. At a large dairy barn cows are:		
(1) Washed (by hand — by stream of water from a hose).	82	42
(2) Milked (in the barnyard — in the barn).	87	82

Topic	Questions	Five Cities Per cent Correct Answers X	C
	(3) Fed from a (bucket — trough).	85	72
	(4) (Tied by ropes in stalls — kept in place by means of bars which hold their heads.)	86	73
	3. At the company dairy:		
	(1) Milk is received in (bottles — cans).	83	74
	(2) When milk arrives it is poured into (vats — buckets).	86	76
	(3) The milk is stirred by (hand — machine).	86	82
	(4) Bottles are carried to filling machine (by hand — by conveyor belt).	91	85
	4. Boxes of bottled milk are shipped from the company dairy to the city with ice packed (in — around) the boxes.	42	34
	Average for topic	76	64
Wheat			
	1. A man (walks — does not walk) behind a tractor plow to guide it.	81	73
	2. The pioneer sowed wheat by (dropping it in holes and covering with a hoe — scattering it over the ground).	82	73
	3. Wheat is generally planted by a machine which (scatters it over the ground — drops it in rows).	86	64
	4. Wheat is (cultivated — not cultivated) with harrows during the growing season.	40	36
	5. After wheat is cut it is (raked into piles like hay — bound into sheaves).	81	80
	6. When cut with a cradle the wheat (falls scattered over the field — is laid down in long rows).	76	62
	7. The pioneer beat out wheat grain from the straw (in the field — on a threshing floor).	74	68
	8. The straw from a threshing machine is (blown into a stack — bound into bundles).	69	59
	9. Wheat is threshed (on the farm — at the elevators).	86	83
	Average for topic	75	67
From Wheat to Bread			
	1. The water wheel of a pioneer grist mill was (inside — outside) the mill.	92	84
	2. In a modern flour mill wheat is passed through (one — several) grinders.	93	93
	3. Flour is sifted (through screens on a conveyor belt — through cloth stretched in boxes).	46	36
	4. Flour (runs into sacks from chutes — is scooped into sacks from bins).	79	70

Topic	Questions	Five Cities Per cent Correct Answers X	C
	5. Flour is shipped to a large bakery in (metal bins — sacks).	90	85
	6. In making bread, salt is put into the mixture (before — after) the dough is kneaded.	89	81
	7. In a modern bakery dough is:		
	(1) Kneaded by (hand — machine).	93	82
	(2) Kneaded (on long tables — in closed vats).	80	62
	(3) Put in baking pans by (hand — machine).	53	28
	8. In a modern bakery:		
	(1) Bread is baked in (stoves — long ovens).	96	94
	(2) (One loaf is — several loaves are) baked in each pan.	66	33
	(3) Bread is wrapped by (hand — machine).	89	86
	Average for topic	81	70
Cattle			
	1. When herding cattle on the range, cowboys get their meals at the (ranch house — chuck wagon).	78	77
	2. Range horses are kept in a (barn — corral).	91	83
	3. On a cattle ranch alfalfa is cut with a (mowing machine — scythe).	82	71
	4. The rake used for collecting alfalfa is (drawn behind — pushed along in front of) the horses.	76	25
	5. Alfalfa grown on the ranch for range cattle is usually (baled — piled loose in stacks).	77	77
	6. Alfalfa grown on the ranch for range cattle is stored for winter use (in the barn — outside the barn).	34	14
	7. In treating cattle for ticks (the liquid is sprayed on the cattle — the cattle are driven into the liquid).	90	72
	Average for topic	75	60
Corn			
	1. Ears of corn for seed are selected usually (in the field — at the corn crib).	50	44
	2. Seed corn is stored (in baskets — on racks).	81	61
	3. Seed corn is tested by sprouting grains from selected ears in a (sprouting box — roll of damp cloth).	93	64
	4. Corn is (cultivated — not cultivated) during the growing season.	80	69
	5. When corn is planted in the same field year after year the (seeds will not sprout — corn plants will be stunted).	77	57
	6. Corn is cut up for ensilage (when green — after being dried).	78	72
	7. The husks are removed from corn by (cutting — tearing).	74	73
	8. Pointed pegs are used to (husk — shell) corn.	79	50

Topic	Questions	Five Cities Per cent Correct Answers X	C
	9. The eggs of the corn borer are laid in the (ground — corn stalk).	94	88
	10. The corn borer is killed by (burning off the corn stalks — spraying with poison).	70	67
	11. Corn is usually shipped to the starch factory (shelled — on the cob).	77	60
	12. At the starch factory starch is collected in (settling pans — on disk wheels).	69	41
	Average for topic	77	62
Cotton Growing			
	1. The cotton plant usually:		
	(1) Grows (about half as tall as a man — taller than a man).	86	83
	(2) Blossoms (before — after) the leaves come out.	79	69
	(3) Grows bolls (only at the top of the plant — at various heights on the plant).	79	66
	(4) Grows the cotton fiber (inside — around) the boll.	69	69
	2. The boll weevil:		
	(1) Lays its eggs in the (stem — bud) of the cotton plant.	93	71
	(2) Is killed by spraying poison on the (seeds before planting — the growing cotton plant).	82	72
	(3) Causes the (bud — whole plant) to wither.	45	33
	3. Cotton is picked:		
	(1) From plants (which are growing in the field — which have been cut and bound into sheaves).	91	88
	(2) Usually by (machines — hand).	93	84
	(3) And weighed (in the field — at the barn).	90	67
	4. Cotton is stored in the warehouses (before — after) the seeds and lint are separated.	75	76
	5. At the warehouse cotton is (moved about on trucks — carried by men).	79	69
	6. Cotton is fed into the gin (with a pitchfork — by suction).	84	75
	7. Samples of cotton:		
	(1) Are taken (from the field — from the bales).	93	72
	(2) Are (made into rolls — placed in small envelopes).	58	46
	Average for topic	80	69
Irrigation			
	1. Storage dams are used to (back up a reservoir of water — turn the water of a stream into a new channel).	82	78
	2. A storage dam for irrigation purposes is built on a stream	41	33

Topic	Questions	Five Cities Per cent Correct Answers X	C
	having a supply of water that is (adequate for irrigation at all times — not adequate at times).		
	3. A diversion dam:		
	(1) Is built (across — into the side of) a stream.	49	34
	(2) Is built on a stream with a supply of water that is usually (adequate for irrigation at all times — not adequate at times).	61	60
	4. Alfalfa is usually grown in irrigated fields that are (large enough — not large enough) for power-driven harvesting machines to be used in them.	17	17
	5. In the San Diego region water for irrigation is usually pumped from (irrigation ditches — underground sources).	45	36
	6. Water is carried (over — through) mountains in open conduits.	67	63
	7. Orchards are usually irrigated by (flooding — furrowing).	54	57
	8. The amount of water taken from an irrigation ditch is measured by (letting it flow into a tank — finding the depth of water flowing over a small dam in the ditch).	84	66
	Average for topic	56	49
Bituminous Coal			
	1. Before blasting, a machine is used to make a deep cut at the (top — bottom) of the coal seam.	73	63
	2. Mine cars are stopped by (a wheel on the car which sets the brakes — blocks of wood placed under the wheels of the car).	70	24
	3. When a loaded mine car reaches the mine shaft, it is (unloaded — run onto an elevator with its load).	80	60
	4. Mine cars are unloaded at the tipple (with shovels — by tilting the cars).	90	77
	5. At the tipple, coal is loaded (by steam shovels — by means of chutes) into flat cars for shipping.	80	62
	6. Coal is sorted into sizes by (hand — shaker sieves).	90	79
	7. Slate is removed from coal by (shaker sieves — hand).	76	49
	8. Coal is carried (on conveyor belts — in cars) to the top of the tipple where it is to be cleaned and sorted.	56	64
	9. Coal for coking is put in at the (top — side) of the coking oven.	69	56
	10. Coke is removed from the coking oven by (pushing it out through the side of the oven — letting it drop through the bottom of the oven into a bin).	71	47
	11. Coke is taken from the oven (while still hot — after it has become cool).	90	68
	Average for topic	77	52

Topic	Questions	Five Cities Per cent Correct Answers X	C
Iron Ore to Pig Iron			
	1. Iron ore is carried out of the open pit mines at Mesabi by (elevators — trains).	87	69
	2. Mesabi iron ore is loaded at the mine with (hand — steam) shovels.	90	70
	3. In the mines of Mesabi (few — many) men are needed to mine the ore.	48	40
	4. Iron ore is unloaded at the Duluth piers from the ore cars by (tilting the cars — opening the bottoms of the cars).	85	76
	5. Ore boats are unloaded by (steam shovels — chutes).	63	55
	6. It takes (more — less) time to load a boat than to unload one.	70	67
	7. The locks at the "Soo" Canal (lift — lower) boats from Lake Superior to the level of Lake Huron.	81	73
	8. In lowering a boat through the "Soo" Locks the gates behind the boat are closed (before — after) the gates in front of the boat are opened.	48	56
	9. A blast furnace is charged by means of (steam shovels — cars running to the top of the furnace).	88	62
	10. Ore, limestone, and coke are (mixed — not mixed) together before being placed in the blast furnace.	51	50
	11. Molten iron is drawn from the blast furnace (into pipes — into trenches).	75	63
	12. Slag is drawn from the blast furnace (before — after) the iron is drawn out.	65	51
	Average for topic	71	61

APPENDIX IV

TOPICAL TESTS IN GENERAL SCIENCE

(Given at intervals of two weeks during the experiment.)

THE MEAN SCORES OF THE X AND THE C GROUPS ON EACH QUESTION OF THE TOPICAL TESTS IN GENERAL SCIENCE

Hot Air Heating

Questions	Mean Scores		Difference $\frac{X - C}{C}$
	Experimental N = 168	Control N = 174	
1. The square on the right represents a room. Draw an arrow on each of the four sides of the figure to show the direction the air moves when there is a fire in the fireplace.	1.4	1.4	.0
2. Describe the parts that radiation, convection, and conduction play in the heating of a room by a hot air furnace. Begin your description at the fire.	0.7	1.2	−.42
3. Describe each of the five means of heating from the campfire to the hot air furnace, and show in what way each new method was better than the preceding one.	6.8	7.1	−.04
4. Explain what causes convection currents, and give illustrations.	1.2	1.5+	−.20
5. Draw a diagram showing the main features of a hot water heating system. Write on the diagram the names of the different modes of heat transference where they occur.	1.7	2.6	−.35
6. Describe the action of an automatic heat regulator, and tell how it keeps a room at a uniform temperature.	1.4	1.3	+.08
7. Why is it necessary to add moisture to the air in a hot air heating system?	0.7	0.8	−.125
8. How is moisture added to the air in a hot air heating system?	1.5−	1.3	+.15
9. Would a refrigerator be colder with the ice at the bottom than at the top? Explain why.	1.5−	1.6	−.06
Mean Scores on Nine Questions	16.8	18.6	

Atmospheric Pressure

Questions	Mean Scores		Difference $\frac{X - C}{C}$
	Experimental N = 167	Control N = 171	
1. With the aid of a diagram explain just how you would make a mercury barometer.	2.9	4.1	−.29
2. Draw a diagram of a lift pump and explain its action.	2.3	2.1	+.10
3. Describe and explain the effect of high altitudes on: (1) a mercury barometer, (2) an aneroid barometer, (3) breathing, (4) boiling eggs, (5) lifting power of a balloon.	3.0	3.7	−.19
4. Explain why the sides of an air-tight box made of thin paper are not crushed by the air pressure of 15 pounds to the square inch.	0.6	0.6	.0
5. What must be done before a hollow body will be crushed by the pressure of the outside air?	0.8	0.7	+.14
6. Describe the action of a vacuum cleaner and explain why the dirt is drawn in.	2.0	1.6	+.25
7. Draw a diagram of a siphon and explain how it works.	1.4	1.4	.0
8. Explain the chief cause of winds, and tell how this accounts for the land and sea breezes along the shore of a body of water.	0.6	0.4	+.50
9. How may one use a barometer to determine the weight of that part of the sea of air which is directly above a given area?	0.1	0.0	+.89
Mean Scores on Nine Questions	13.7	14.7	

Compressed Air

Question	Mean Scores		Difference $\frac{X - C}{C}$
	Experimental N = 166	Control N = 176	
1. Draw a diagram of a hand tire pump, showing the valves. Explain how the pump works, telling what happens on the down-stroke and on the up-stroke.	5.1	4.0	+.275
2. If a certain quantity of air occupies a volume of 1 cubic foot when the pressure on it is 15 pounds to the square inch what will be its volume when the pressure is increased to 30 pounds to the square inch? State the law which is involved.	0.5–	0.6	–.17
3. Explain how air acts as a cushion. Give three examples.	1.9	1.9	.0
4. What is the purpose of the air dome on a fire engine? Describe its action.	1.1	0.5–	+1.20
5. Describe the operation of the air brakes on a railroad train.	2.8	2.6	+.08
6. Show how compressed air is used to operate four labor-saving tools.	2.9	1.7	+.71
7. Describe the main parts of a tree sprayer and explain how it produces a steady spray at high pressure.	1.4	1.2	+.17
8. How is the pressure in the air hose at a filling station produced and maintained?	0.9	0.9	.0
Mean Scores on Eight Questions	16.6	13.3	

Water Cycle

Question	Mean Scores: Experimental N = 173	Mean Scores: Control N = 179	Difference $\frac{X - C}{C}$
1. What is evaporation? Tell the conditions which affect the rate of evaporation and explain how they affect it.	1.8	2.4	−.25
2. Tell what condensation is and what causes it.	0.7	0.9	−.22
3. Explain how trees affect the run-off of surface water.	1.0	1.1	−.09
4. Describe the changes that take place in water throughout the water cycle and draw a diagram to show the relation of these changes to each other.	2.7	3.3	−.18
5. How could a person living near a large lake estimate the depth to which he would have to sink a well? Explain why such an estimate could be made.	0.6	0.5−	+.20
6. Give the reasons why some regions have heavier rainfall than others.	1.2	1.3	−.08
7. Describe the chief ways in which surface water is of service to man.	1.1	1.3	−.15
8. Tell what glaciers are and what they do.	1.9	2.5+	−.24
9. Give the important facts about three kinds of clouds.	5.4	4.6	+.17
Mean Scores on Nine Questions	16.3	17.8	

New York Water Supply

Question	Mean Scores: Experimental N = 178	Mean Scores: Control N = 172	Difference $\frac{X - C}{C}$
1. Describe the Catskill region and tell why it is a good place from which to secure a water supply.	2.1	2.0	+.05
2. Draw a map showing the main features of the New York water supply system.	3.4	3.1	+.10
3. Describe the bodies of water which surround New York City and explain why the city goes so far to obtain its water supply.	2.2	2.4	−.08
4. Describe two ways in which the water is treated to make it more suitable for drinking, and explain the reasons for the treatment.	3.2	3.5	−.09
5. How deep is the water tunnel under the streets of New York City? What causes the water to rise above the street level?	.5+	.5−	.0
6. Describe a reservoir and explain its use in a municipal water supply system.	1.4	1.6	−.125
7. Tell how the water is exposed to the open air in the New York water system and explain the advantages of this exposure.	1.7	1.6	+.06
8. What are the requirements of a satisfactory water supply system?	1.6	1.6	.0
9. Describe the uses of water in a large city.	3.5−	3.2	+.09
10. Show the part that lawyers and bankers play in putting through such a project as the New York water supply system.	.5+	.7	−.29
Mean Scores on Ten Questions	20.1	20.3	

Purifying Water

Question	Mean Scores		Difference $\frac{X-C}{C}$
	Experimental N = 180	Control N = 180	
1. Tell how water is taken from the lake in the water system of Chicago.	2.5−	1.4	+.79
2. What is the purpose of the settling basins in a water supply system?	.95	.8	+.19
3. Describe a settling basin and tell how it works.	2.4	1.6	+.50
4. What is the purpose of filters?	.8	.6	+.33
5. Describe a filter and tell how it works.	3.0	2.8	+.07
6. Describe how city water is treated in order to kill harmful bacteria.	1.7	1.5−	+.13
7. Describe and explain the method of testing city water.	3.5+	1.4	+1.50
8. Describe how harmful bacteria may get into the water (1) of a lake and (2) of a well.	3.0	2.4	+.25
9. Tell how filters are cleaned.	1.6	1.4	+.14
10. What are the duties of a bacteriologist in connection with a city water supply system?	1.7	2.1	−.19
Mean Scores on Ten Questions [1]	21.2	15.9	

Limestone and Marble

Question	Mean Scores		Difference $\frac{X-C}{C}$
	Experimental N = 285	Control N = 302	
1. Describe the steps that are taken in quarrying and preparing limestone for building roads.	3.1	1.3	+1.38
2. Give the composition of limestone and tell how it was formed.	1.5+	1.7	−.12
3. Why is Bedford limestone especially good as building material?	1.1	1.4	−.21
4. Describe the steps by which Bedford limestone is quarried and prepared for use as building material.	2.0	1.5+	+.33
5. Tell what marble is.	1.6	1.6	.0
6. Name two uses of marble and explain what qualities make it valuable for each use.	4.0	4.3	−.07
7. (A) What change takes place when lime is made from limestone? (B) What produces this change?	1.4	1.4	−.0
8. What substances are mixed to make (1) plaster, (2) mortar, (3) concrete	1.0	1.3	−.23
9. Describe a rotary cement kiln and tell how it works.	1.7	1.1	+.55
10. Tell what chalk is and how it was formed.	1.4	1.4	.0
Mean Scores on Ten Questions	18.9	17.1	

Sand and Clay

Question	Mean Scores		Difference $\frac{X - C}{C}$
	Experimental N = 280	Control N = 300	
1. Name two substances which come from granite and tell what products are derived from each.	3.1	2.5	+.24
2. Describe the process of making artificial sandstone blocks.	2.4	1.1	+1.18
3. Describe the chief steps in making plate glass.	5.1	3.3	+.55
4. For what purposes is plate glass superior to ordinary glass? Explain why.	1.9	1.75	+.09
5. Describe how bricks are arranged in a kiln for firing.	1.0	1.3	−.23
6. Would sand from the seashore be the best kind for making plaster? Explain.	1.0	.9	+.11
7. Describe how grindstones are quarried and shaped.	2.9	.5	+4.80
8. Tell what slate is and how it is obtained.	1.7	1.2	+.42
9. Describe how a piece of pottery is molded into shape.	2.1	1.9	+.11
10. Tell how pottery is glazed and why.	2.9	1.45	+1.00
Mean Scores on Ten Questions	24.1	15.7	

Reforestation

Question	Mean Scores		Difference $\frac{X-C}{C}$
	Experimental N = 242	Control N = 270	
1. Explain how timber may be cut (1) to avoid waste, (2) to prevent fires.	2.1	2.5−	−.16
2. Explain the effect of cutting away all the trees from a slope upon (1) the flow of streams, (2) the erosion of soil.	2.3	2.6	−.12
3. What care should be taken to prevent a camp-fire from injuring a forest?	2.2	2.0	+.10
4. Describe how seedlings which are awaiting to be planted are "heeled in."	2.1	1.3	+.62
5. How are the fields marked off so that tree seedlings may be planted the right distance apart?	1.4	1.1	+.27
6. In transplanting a seedling how can a person tell how much of it should be put under the ground?	.9	.7	+.29
7. Why is there danger of a shortage of timber in the United States and what should be done to prevent it?	2.9	2.9	.0
8. In what ways is a forest which has been planted by man likely to be better than one which has grown up naturally?	1.9	2.1	−.10
9. What is the effect on forest trees of planting them close together?	1.2	1.3	−.08
10. Give several reasons why the planting of forest trees is a good school activity.	1.9	1.8	+.06
11. If a class is to plant forest trees how might the work be divided among several groups of pupils?	2.9	2.3	+.26
Mean Scores on Eleven Questions	21.6	20.6	

Planting and Care of Trees

Question	Mean Scores Experimental N = 254	Mean Scores Control N = 270	Difference $\frac{X-C}{C}$
1. Tell the best time for transplanting trees and explain why this time is best.	2.6	2.6	.0
2. In resetting trees why is it better to use a grafted nursery tree than a wild tree from the woods?	1.2	1.1	+.09
3. How can one tell from the appearance of a tree that it has been grafted?	.8	.8	.0
4. Describe the work of the roots, trunk, and leaves of a tree: (a) roots, (b) trunk, (c) leaves.	3.2	3.4	−.06
5. Describe how the roots and branches of a tree are pruned in transplanting: (a) roots, (b) branches.	1.8	1.3	+.38
6. Why should the soil be packed about the roots of a transplanted tree?	.9	.9	.0
7. In what ways do insects injure trees?	2.4	2.3	+.04
8. Describe what things may be done to destroy tree insects.	2.6	2.5+	+.04
9. Describe the stages in the life history of the codling moth.	3.7	3.4	+.09
10. How may one recognize the tent caterpillar?	1.3	.6	+1.17
11. What things that injure trees should people avoid doing?	1.9	2.1	−.10
Mean Scores on Eleven Questions	22.4	21.1	

APPENDIX V

TOPICAL TESTS IN GEOGRAPHY

THE MEAN SCORES OF THE X AND THE C GROUPS ON EACH QUESTION OF THE TOPICAL TESTS IN GEOGRAPHY

New England Fisheries

Question	Mean Scores		Difference $\frac{X-C}{C}$
	Experimental N = 350	Control N = 325	
1. Describe the large and small boats used in cod fishing.	5.0	5.3	−.06
2. Tell what a cod fisherman does from the start to the finish of a fishing trip to the Grand Banks.	6.8	5.4	+.26
3. Explain why the work of a cod fisherman is hard and dangerous.	2.6	2.8	−.07
4. Sketch quickly a rough map of the New England coast from Massachusetts to Maine. Show the location of Boston and of Gloucester. Draw and name Newfoundland and the Grand Banks.	3.2	2.5+	+.28
5. Explain why the Grand Banks are a good place for cod fishing.	2.0	1.9	+.05
6. Tell the things that are done to cod fish when they are to be shipped as dried fish.	4.4	3.4	+.29
7. Tell the things that are done to cod fish when they are to be shipped as fresh fish.	2.0	1.2	+.67
Mean Scores on Seven Questions	26.0	22.7	

Wisconsin Dairies

Question	Mean Scores		Difference $\frac{X-C}{C}$
	Experimental N = 352	Control N = 334	
1. Tell all the things that are done in a modern dairy to keep the milk clean and sweet.	3.6	3.6	.0
2. Describe the means of transporting milk from the modern dairy farm to the city.	2.0	1.8	+.11
3. Explain why good transportation is necessary in the dairy industry.	1.4	1.5−	−.07
4. Describe the chief kinds of labor-saving machinery used in the production and marketing of milk.	2.6	2.5+	+.04
5. Describe the feeding of dairy cows in summer and in winter.	2.6	2.8	−.07
6. Tell the things that cause large dairies to be located where they are and show why each thing is important.	1.5+	1.7	−.12
Mean Scores on Six Questions	13.7	14.0	

Wheat

Question	Mean Scores		Difference $\frac{X - C}{C}$
	Experimental N = 360	Control N = 342	
1. Describe pioneer methods of raising wheat including preparing the ground, sowing the seed, harvesting, and threshing.	3.6	2.7	+.33
2. Describe modern methods of preparing the soil and sowing the wheat on large wheat farms.	2.1	2.1	.0
3. Describe the steps in the harvesting and threshing of wheat (1) when two machines are used and (2) when one machine is used.	2.4	2.1	+.14
4. Compare the farms in the winter wheat region with those in the spring wheat region on the following points: (1) size, (2) use of machinery, (3) other products raised.	1.1	1.1	.0
5. Which of the two kinds of wheat is raised in North Dakota? Which kind is raised in Illinois?	1.3	1.0	+.30
6. Show how differences in climate govern the planting, growing, and harvesting of spring and winter wheat.	0.9	1.0	−.10
7. Explain the purpose and the location of large and small storage elevators.	1.4	1.5+	−.07
Mean Scores on Seven Questions	13.0	11.6	

Cattle

Question	Mean Scores		Difference $\frac{X - C}{C}$
	Experimental N = 372	Control N = 346	
1. In what part of the United States are most of the cattle ranches located and describe the region.	2.1	2.1	.0
2. Describe the work of a cowboy and the kind of life he leads.	3.3	3.3	.0
3. Explain why more land is required for a cattle ranch than for a dairy.	.4	.5+	−.20
4. What are the purposes of a round-up?	1.8	1.5+	+.20
5. Describe how cattle are sent to market.	3.0	2.7	+.11
6. Tell how alfalfa is harvested.	3.4	2.1	+.62
7. Explain why ranchers raise alfalfa for winter feeding of their cattle.	1.2	1.2	.0
Mean Scores on Seven Questions	15.2	13.5+	

Corn

Question	Mean Scores: Experimental N = 369	Mean Scores: Control N = 344	Difference $\frac{X-C}{C}$
1. Tell about the selection of seed corn including:			
(1) Why it is selected	.8	.8	.0
(2) What are the qualities of a good ear of corn.	1.5+	1.7	−.12
(3) How the good ears are picked out and stored.	1.4	.7	+1.00
(4) How seed corn is tested.	4.4	2.7	+.63
2. Describe the planting of corn explaining how it is different from the planting of wheat.	2.0	2.3	−.13
3. What is the effect of planting corn on the same ground year after year? What method of farming is used to prevent such a result?	1.9	2.1	−.10
4. Describe the usual method of husking corn in the field.	1.7	1.3	+.31
5. Tell where the corn borer lives and how the farmer kills it.	2.1	1.9	+.11
6. Give the chief uses of corn.	3.2	3.4	−.06
Mean Scores on Six Questions	18.9	16.8	

Cotton Growing

Question	Mean Scores[*]		Difference $\frac{X - C}{C}$
	Experimental N = 611	Control N = 606	
1. Describe the planting of cotton telling: (1) How the soil is "bedded up," (2) how the seeds are planted.	3.1	2.6	+.19
2. Tell how the cotton plants are thinned out.	2.5+	1.5+	+.67
3. Describe the way cotton is cultivated.	1.3	1.0	+.30
4. What is the boll weevil?	2.6	2.5−	+.04
5. How does it affect the cotton boll?	2.9	2.3	+.26
6. How is the boll weevil destroyed?	2.9	1.7	+.71
7. Describe the way cotton is picked.	2.4	2.3	+.04
8. Why is the cotton weighed in the field?	1.0	0.8	+.25
9. Describe the climate which is favorable to cotton growing.	1.7	1.8	−.06
10. Explain the importance of the cotton gin.	1.2	1.2	.0
Mean Scores on Ten Questions	21.5	17.6	

Irrigation

Question	Mean Scores		Difference $\frac{X-C}{C}$
	Experimental N = 626	Control N = 627	
1. Draw a map of the southern part of the State of California, locating the Imperial Valley and the San Diego area. Show on the map the source of irrigation water supply for each area.	1.3	1.1	+.18
2. Tell the kind of dam used in (1) the Imperial Valley irrigation system, (2) the San Diego area.	.8	.7	+.14
3. Describe a diversion dam.	.9	.9	.0
4. Describe a storage dam.	1.1	.9	+.22
5. Explain why a diversion dam is used in some places and a storage dam in others.	.5+	4	+.25
6. Name five of the chief crops raised on irrigated lands.	3.5+	2.8	+.25
7. Describe the methods used to get water from the dams to the farms.	2.6	2.1	+.24
8. Describe two methods of getting the water onto the fields.	1.8	.7	+.14
9. Explain how irrigation reduces the risk of farming.	.6	.6	.0
Mean Scores on Nine Questions	12.0	10.1	

Bituminous Coal

Question	Mean Scores		Difference $\frac{X - C}{C}$
	Experimental N = 615	Control N = 600	
1. Tell what coal is and how it is formed.	2.1	2.1	.0
2. How is the coal broken away from the mine breast?	3.1	2.4	+.29
3. How is the coal carried from the mine breast to the outside of the mine?	2.0	2.2	−.09
4. Tell what the chief dangers in coal mining are and what things are done to avoid them.	4.3	4.2	+.02
5. Describe the way coal is sorted.	1.9	1.2	+.58
6. What things are done to coal to prepare it for coking?	.6	.4	+.50
7. Describe a beehive coke oven.	1.9	1.6	+.19
8. Tell how coke is removed from a retort oven.	1.0	.2	+4.00
9. Why does the coal not burn up when it is heated in the coking oven?	.7	.4	+.75
10. Explain the reasons why we should not waste coal.	.8	.9	−.11
Mean Scores on Ten Questions	18.5	15.6	

From Iron Ore to Pig Iron

Question	Mean Scores: Experimental N = 575	Mean Scores: Control N = 583	Difference $\frac{X-C}{C}$
1. Tell how an open pit iron mine looks.	1.6	1.6	.0
2. Describe how the iron ore of an open pit mine is taken from the ground.	2.2	1.8	+.22
3. Describe how the iron ore is loaded on the ore boats.	2.5−	1.9	+.32
4. Describe the steps in putting a boat through the locks on its trip from a higher to a lower level.	2.0	1.6	+.25
5. Describe the smelting of iron ore telling (*a*) the materials that are put into the furnace, (*b*) how the furnace is heated, (*c*) how the iron is separated from the other substances.	4.0	3.6	+.11
6. Describe how the ore is unloaded from the boats.	1.7	.9	+.89
7. Give reasons why the blast furnace fires are not allowed to go out at night.	1.3	1.4	−.07
8. (*a*) Draw an outline map of the Great Lakes omitting Lake Ontario. (*b*) Write in the names of the following: (1) Mesaba mines, (2) Lake Superior, (3) Lake Michigan, (4) Lake Huron, (5) Lake Erie, (6) "Soo" Canal, (7) Gary, (8) Cleveland. (*c*) Trace the route from the mines to Gary. (*d*) Trace the route from the mines to Cleveland.	5.2	4.0	+.30
Mean Scores on Eight Questions	20.5−	16.9	

From Wheat to Bread

Question	Mean Scores		Difference $\frac{X-C}{C}$
	Experimental N = 367	Control N = 349	
1. Describe in order the chief things that are done to wheat in making it into flour.	4.2	3.2	+.31
2. In what ways is the modern flour mill superior to the old grist mill?	2.5+	2.5–	.0
3. Explain how the methods of the modern flour mill affect the quality of the flour.	1.3	1.1	+.18
4. Describe in order the steps in the making of bread in a large modern bakery.	4.4	3.9	+.13
5. Give the chief advantages in the use of machinery in modern flour mills and bakeries.	1.3	1.3	.0
6. What features of the modern bakery make for the production of good bread of uniform quality?	1.3	1.4	–.07
Mean Scores on Six Questions	14.9	13.4	

APPENDIX VI

ANSWERS OF EXPERIMENTAL TEACHERS TO A LIST OF QUESTIONS SUBMITTED TO THEM AT THE END OF THE EXPERIMENT

A STATISTICAL study and a discussion of these answers are presented in Chapter VIII. Teachers are identified by number. A blank following a teacher's number indicates that that teacher failed to answer the question.

Question 1. Are you able to arouse more interest on the part of the children with the use of the film than you have usually obtained in your classroom work without the film?

1. Yes, and I find it especially helpful in arousing interest of a low group.
2. The classes as a whole have manifested more interest since the experiment started than any time before. My failures were reduced for the third quarter from 18 per cent to 6 per cent. Pictures did this.
3. Yes. Children who as a rule do not respond were among leaders during the experiment.
4. Decidedly more. They search for information, and bring in reports on topics that have not been assigned, but which bear directly upon the subject.
5. The children are highly interested in the pictures. In fact, they are so interested they all wish to discuss the pictures at one time. They, also, show their interest by scores of questions. Every day they ask if they are going to see a picture that day, and are deeply disappointed if they do not.
6. More intensive interest was aroused on the part of the children, because each child seemed to have a vital motive in finding out what he did not know.
7. Yes, but this interest has suffered because of the short period which prevented self-expression.
8. Yes, very much more.
9. With it.
10. Yes.

11. Absolutely yes. The dullest and most difficult subjects can be made interesting with the use of films.
12. Yes.
13.
14.
15. Yes, I think I got more interest with the film than I have usually had with Social Science, although with a selected class in Social Science I have had more enthusiasm than I have secured with the film.
16. The first showing of the picture always arouses the interest of the children. They always seem eager for the next one. The interest shown afterwards is about the same as that shown in a well-conducted recitation. It was very difficult to hold them down to the picture itself. That is, they wanted to discuss things related to ideas brought out in the film, but due to our limited time on each topic, such discussions were impossible. I do think that pictures can help to stimulate interest.
17. Yes.
18. The interest on the part of the children has been greater with the use of the films. Children who were doing failing work before have been spurred on to greater interest by means of the films and are making passing grades.
19. Yes, very much more. At recesses, before and after school, they come to me and tell me this or that, to show me articles in books, to ask for drawing paper and so forth, for drawings, posters, and so forth. They volunteered to make a sand table.
20. The films have provided groundwork for the child's thinking and growth in knowledge. The new field of experience opened up by the films has aroused a more real interest on the part of the children than I have usually obtained before.
21. Yes, each film presents situations that children do not get through the recitation or problem method of study.
22. Yes, infinitely more so. This is obvious by the fact that so many more children are willing to talk and take part. There is an eagerness to participate.
23. Yes, more than was usually done before we had the films, but on the part of a few pupils. I noticed that the aroused interest was always on the part of a small group. The situation was a passive rather than an active one.
24. No. Their interest is confined to the picture and not so much the subject matter.

25. I am. It removed the lesson from the remote abstract to the definite concrete.
26. Yes, each film has had some particular interest or appeal that has been a very good motive.
27. I can't say that there is more interest aroused than in the ordinary work. However, I think, this is largely due to the fact that some of the topics had been studied before.
28. Yes, the film aroused a greater interest, and I was able to keep up the interest longer, than if I had taught the topic without the picture.
29. Most decidedly so and especially with the slow sections.
30. Much more with the better groups, and also with all groups on the last four units. I think that the other work was too hard and the time too short for the lower groups.
31. Yes. April 9 being Easter Monday about fifty pupils were absent. I made an announcement — "Thursday night after school I will show the entire film to those who were absent Monday." Those pupils had seen units one and two. Thursday night, all but one, who sold papers, were present. Other pupils wanted to come, to decide on some points we had been discussing in class, but as it was an experiment they did not come.
32. No. However, the use of the film has been of great interest to the children. The use of the film has not permitted as much pupil activity. I think I had greater interest (individual) before through my way of teaching.
33. My children always enjoyed Geography, but they have been more eager for it than ever before since we are using the films daily, as they do not understand English well and pictures speak a universal language.
34. Yes.
35. Yes — because most of the children in our school are either foreign born or of foreign parentage, and having language difficulty pictures present a real story, to children, which they wouldn't get from reading.
36. Yes. The children are more willing to express their opinions, and they do more talking outside of class than formerly.
37. Nearly every pupil in the room is intensely interested in Geography.
38. Yes.
39. A great deal more interest was aroused than ever before.

40. Yes, they responded to questions and suggestions very well.
41. No, because we have used films as supplementary work.
42. Yes, much more interest is shown at first, but the interest lags the third or fourth day.
43. Yes. Pupils are more interested in any subject when a film is used. They seem to be more observant of the things in their city.
44. Yes. In certain phases — as how compressed air machines work, uses of building material. If given time enough for each topic, without doubt, the interest would be much greater.
45. Yes. I have noted a free discussion at all times. An intense desire by drawing, handwork, or hunting pictures or articles relating to topics. A willingness to write up a topic; self-activity in letter writing for information or literature, or planning visits to plants represented in our vicinity.
46. Yes. Pupils have gone to city libraries many times voluntarily to find more. Anything new found on subjects is brought to class with the enthusiasm of a great "discoverer."
47. Yes.
48. Yes.
49. For several years we have used films in teaching an industry, and I have always found, as during the present experiment, that the film aroused greater interest in a subject.
50. Yes, the class as a whole showed more interest and it seemed more real to them, but we have had films in our school for some time, to a limited extent.
51.
52. A great deal more interest was shown by the children with the films.
53. The children seemed to take a deeper interest in those film topics than usual and delved into many side issues, such as the construction of a dam in Irrigation and the making of steel under Iron Ore to Pig Iron.
54. Yes, especially in the teaching of such topics as Compressed Air, New York Water Supply, Purifying Water, Limestone and Marble, and Sand and Clay.
55. Yes.
56. Yes. The films were a source of enthusiasm that did not lessen or diminish.
57. Decidedly so. Children anticipate films and show interest from the start of the reel with contributions of library books,

illustrative material, and information copied from reference books.

58. Yes. The action attracts. Children ask more questions. Express desires for various details not shown in the film.
59. Yes. Many pupils visited libraries every week, some parents purchased books. Research shown by pictures, clippings, etc. Brought to class.
60. Yes.
61.
62. From the testimonial of parents who tell me of the interesting discussions their children carry on outside of school, I should say "yes," to this. From the questions and discussions in the classroom I see a decided increase in their interests.
63. Yes. The children come to talk about the topics before school and at noon.
64. Yes, because the children have gone to the stores and to various business places getting raw specimens of the things that are described in the film. A boy went to the coalyard and got coal and coke for the class.
65. There is a more serious attacking of work in some of the low mental groups, but I do not have as much enthusiasm for the subject matter as when we base our work on first aid, care of baby, and so forth.
66.
67. Yes, a greater interest is shown. Many points which otherwise would not have been understood, were quite easily comprehended.
68. Yes.
69. Yes. Through the wealth of visual material many suggestions are automatically brought forth. Much interest is shown, correlated subjects, always some new phase brought forth.
70. Yes. Children have been intensely interested in all work connected with the film. Enthusiasm of mediocre as well as of brighter has been aroused.
71. Decidedly so.
72. Yes. It was quite remarkable the interest which the film stimulated.
73. Yes.
74. Yes, it seemed to arouse more interest and make the work more vital.
75. Decidedly. The film makes real and actually shows the child

industries and places about which he has heard but has never dared to hope to be able to visit. Of course he is interested and doesn't wish to lose a bit of it.

76. Yes, unquestionably.
77. Yes.
78. Emphatically, yes.
79. Yes.
80. Yes, after the children got used to the idea that films were for other purposes than entertainment.
81. Yes.
82. If the film is clear enough it is invaluable in arousing interest. (Could have aroused more interest without the Irrigation film and guide than with it.)
83. Yes. I hope the school board will provide us with a machine next year.
84. Unquestionably.
85. Yes.
86. I am hardly able to answer this question, for I did not have the group before the experiment was started; neither have I had a similar group. However, I should think that this group would respond more to pictures.
87. Yes.

Question 2. Are you able to develop a more *sustained interest* by the use of the film? In other words, do your pupils bring in more material on a topic taught by the film after the study of such topic has been completed than has been usual in your teaching experience?

1. Yes, every day some pupil brings a clipping or picture on some picture we have had in the past.
2. All you have to do is to ask for extra material and it is forthcoming. My trouble has been that I have not had space to keep all of the material each class has brought. The interest has lasted till the end of the experiment.
3. Yes, material on all subjects studied is still being brought by pupils.
4. Yes. For weeks after the topic is finished a picture or a clipping is brought in and discussed without stimulation on the part of the teacher.
5. Yes, they are still bringing pictures on New England Fisheries

and other topics already taught. They also add to their notebooks whenever they come across material on subjects they have studied.

6. Interest was sustained because it carried over in other subjects. The stories in the Readers and other textbooks, that touched upon the topic, were read more eagerly. A number of the children would find on their maps, places and trade routes of Cod Fishing and the other topics many weeks after the topic was completed. Pictures and interesting compositions were collected. A topic shown would recall activities of a topic shown many weeks previous. The cultivation of cotton recalled the cultivation of wheat and corn, and the mining of iron ore recalled the mining of coal.
7. Yes, and the material comes over a longer period of time. Only yesterday an article on fishing was brought to me.
8. Yes. Current events are often noticed and mentioned as relating to a film weeks old.
9. Yes.
10. Yes.
11. Yes. They like to bring in samples, clippings, and even "ads" on the various subjects.
12. Yes.
13.
14.
15. Some material has been brought in after a film is finished, but usually the child's interest changes with the changing films.
16. It is rather difficult to answer the question on sustained interest. If we had more time for open discussions, I believe the "sustained interest" idea would develop more. I have promised to discuss some of the things with my pupils after the experiment is over. One boy is going to bring in different samples of clay and fire brick and give a talk to his class later on.
17. If sustained interest means only what is indicated in explanation, my answer is "yes, the films do help to develop a more sustained interest." The only difficulty has been that some pupils have felt that seeing the film was sufficient, so were unable to see the necessity or importance of further study on the topics.
18. A greater amount of material has been brought in on topics

taught by the film. It kept me busy trying to keep up with the materials the children brought.

19. Yes. In fact, one child brought in a wooden fish carved by her grandfather weeks after the cod-fishing film had been shown. They still discuss points in the films shown earlier.
20. Much material was brought in while studying a topic, but when the next project was introduced, the children's interests were concentrated on the new subject and they stopped bringing materials.
21. The interest is very alert and children try to obtain material, but homes do not seem to furnish much material outside of newspaper and magazine clippings — these are limited.
22. Yes. Several pupils have said, at different times, that they would be able to see some of the things the pictures showed when on their summer vacations.
23. Yes, I was able to develop a more sustained interest. More material was brought in.
24. No.
25. I am, and they do. The children's interests have been led far afield from the original starting ground — and "disconnected" ideas joined.
26. Their homes do not seem to furnish much material of the kind needed. However, this is not due to lack of interest on part of children.
27. No.
28. My pupils brought in a great deal of material for each topic, but no more than they always do in my work.
29. I have the type of child that has always showered me with material, so that the increase has been slight.
30. Yes. The units on Sand and Clay, and Marble and Limestone were completed over two weeks ago, and to-day a couple of children told me that they had seen some limestone and wanted to know if they should bring it.
31. Yes. Material has been brought several times after a topic is completed. April the tenth a picture was brought on "Fishing," the first unit.
32. No. That is not to the discredit of the film. The film and the method of study with the pamphlets did not give opportunity. Sustained interest was held all the time due to the interesting things brought out in the film.
33. Yes. The children have brought in more reading material

since the films have been in use. Formerly they brought only pictures and specimens.

34. Some material was brought in after topic had been completed, such as clippings, pictures, and books. Few children reported visits to dairy farms, mills, and bakery.
35. More reading material has been brought in than ever before, also more pictures and specimens.
36. Yes. The pupils have brought in more material after the completion of the topic than formerly, and have made remarks to me after a study had been made.
37. Our library table is kept well supplied with books containing articles on topics studied. Many specimens are brought in for study.
38. Yes, in the form of books, but this is my first year in 5–A work. Most of my experience has been in Grade 4.
39. Great interest was manifested throughout the showing of the film. Much material was brought to class.
40. Yes, more pictures and clippings and exhibit articles were brought in than for any previous work.
41. No. Because I use the project method and have all supplementary work planned.
42. Pupils do bring in more material about things we have formerly studied (dairying, wheat, fishing, etc.).
43. I believe pupils bring in more material. Even after the study is completed, material is brought which illustrates this point.
44. Not much more except pictures. One Study Guide asked for pictures and they have hunted pictures for all the other topics with much enthusiasm.
45. Yes, this has been very marked. Hardly a day passes that articles and pictures do not come in on topics first studied. One boy who sells papers on the street stopped me and said, "Coal strike on! I've read it." Coal strikes came up as a new topic.
46. Yes (see above). Home libraries are put to very practical uses. All kinds of pictures, samples of ores, limestone, and so forth. What their fathers know, etc.
47. Yes, they bring in newspapers and magazines.
48. Yes, especially newspaper and magazine items on the subject which they are studying.
49. I have used films before, showing them once or twice during the study of an industry and then, as during the present

study, the film has enabled me to develop a more sustained interest.

50. With some it worked this way, but with others it was hurry on for something new.
51.
52. Children very keen about bringing in pictures, books, samples of different products, such as coal, leather, cotton, etc. Books were even purchased.
53. The children have brought me many articles from their readers, geographies, and magazines on the crops of irrigated lands, cotton quotations in the stock market, and references to milk inspection from their hygiene books. The increased amount of material I received may be partly due to the fact that our former geography work was less familiar, being concerned with European conditions, but I am still inclined to lay much of the credit to the live visual impressions they received from the film.
54. Taking into consideration only the ten topics with which the films deal, and especially the five enumerated above — yes. Sustained interest can be developed without the film, but I found it less difficult to rouse such an interest in the topics enumerated in question No. 1, with the film.
55. Yes.
56. Yes, especially with the child of low mentality who has difficulty in visualizing the printed word.
57. Never in my teaching experience has interest in Geography been more intense or sustained. Never have such a large majority been at white heat to do his or her bit in contributing facts or material.
58. Have always had a great deal of material brought in by any Geography class I have taught, but the films give a clearer idea of the mechanical.
59. Yes. Each pupil has a personal notebook of which he or she is justly proud.
60. Yes, with more urging.
61.
62. I have never had such wealth of material on any given topic brought into the classroom before.
63. I am not sure. The pupils are still bringing articles on all the topics.
64. Yes, with the type of pupil and the grade we have. If the

topics covered a longer period of time we would get a lot more material from them. The time was too short to permit self-expression on the part of the children.

65. I cannot say.
66.
67. Yes. We made quite a collection for wheat, corn, fishing, coal, cattle. Pictures, clippings from papers, magazines, and catalogues. Many articles of food and samples of many things.
68. Yes.
69. Yes. Time does not permit us from using all the material brought in. Films and pictures from commercial houses have been secured through children's efforts as extra work.
70. Interest is much more sustained. In several cases children brought pictures or booklets or showed material they had found in library books after the topic was completed.
71. Yes.
72. Yes. They have rivalled one another in this respect.
73. No. It has never been difficult in this school to have children bring in material.
74. Yes. They brought pictures, clippings, and specimens.
75. Yes. The children have brought in material from unbelievable sources long after a topic has been completed.
76. Had more time been given to each subject, a more sustained interest would have been maintained. I feel very sure, using film without the time element, more can be done.
77. The class has brought in extra material after the film is completed, but due to the pressure of time on the new film work they have neglected the earlier films. They could have used more time on each film.
78. The interest continues long after the time allowed to the subject has expired. This is most unusual.
79. Yes, but the time limit of one week per subject is too short and the interest in one subject is partly lost by the introduction of another subject.
80. I found a marked improvement in this direction. They seemed to pride themselves on finding references.
81. Yes.
82. I have found it easier to develop a more sustained interest by the use of films. (My children are still bringing in cod-fish advertising matter and making farm machinery.)
83. Yes.

84. Yes. A picture of a Gloucester fisherman appeared in an *ad* in a local newspaper a month after the film was shown on Cod Fishing. Many copies were brought. This is one of numerous instances.
85. No.
86. They bring in only what is assigned. Some are much more thorough than others, but, as a whole, there has been little initiative shown by the group.
87. They do. We are making booklets, and pictures that have to do with catching cod fish are still coming to us.

Question 3. How has the film affected the quantity and the quality of the children's reading?

1. They are learning to use reference books, how to select the main points bearing on the topic for discussion. It causes them to visit the library more often and increases their reading.
2. The experiment has enabled the student to do more reading and to organize the material in a logical way. They do not seem to mind looking up material to aid in the development of the topic assigned.
3. The film has increased the amount of reading. Pupils actually spend hours at the library when books are not available at home.
4. They consult reference books available and find other helpful material without any suggestion being made.
5. The children will now read articles they find on Irrigation, Coal, and other topics which they would never have attempted to read before seeing the films. They notice newspaper and magazine articles which base on these subjects more than they would have without these pictures. They would probably read more, if their supply of reading material was not limited.
6. The quality of reading has been improved because the child has an intense desire to find out a definite thing. The study guide was an aid in organizing and judging the information found on the topic. The many contacts the picture gave increased the quantity of reading.
7. This I cannot answer accurately. At first, reading was well chosen and extensive. With each picture it has decreased, due to lack of time for discussion, the children not having the satisfaction of telling us what they had learned or enjoyed.

8. It has increased both and this is continuous throughout the course.
9. More eager to read — greater concentration.
10. The film improved the quantity and quality of reading.
11. They read every scrap of reading matter they can get.
12. Children are quite eager to read any material given them. Their reports have improved.
13.
14.
15. The children have done wide reading with a very definite purpose. I think the film has stimulated reading.
16. I don't know. A few have read quite extensively on some of the subjects but I'm afraid that the big majority have read only what was required of them.
17. There has been a greater amount of purposeful reading of both text material and outside library books and magazines.
18. Material has been read that would otherwise not have been read, if the interest had not been aroused by means of the films. The films have stimulated further reading. The reading became more meaningful.
19. The children bring books to school from the public library and from home relating to the lesson. It seems to me that there is a gain in their ability to pick out more definitely the points in the reading material which relate to the subject.
20. The films did much in opening up "richer fields" for children who have not been extensive readers before. They stimulated many to do further reading and made the reading more meaningful for others. The film way is an effective means of illuminating dry facts. The fact that their research work was along a definite line was of educational value.
21. Great incentive for reading, both quantity and quality has been increased.
22. They read more carefully and, I believe, do more reading.
23. In our regular work we have made use of rather extensive reading of Social Science subjects. Naturally the children are accustomed to read widely. I cannot say that the quantity and quality has been materially affected by the use of the films. When we did projects, the interest was created through class and pupil initiation. The films have created interest but the time has been too limited for class initiation and self-activity.

24. I believe the quality is better, quantity about as usual. Just what is required.
25. Much more reading — a greater interest in reading non-fictional.
26. The film has seemed a very good motivation for reading.
27. The reports have made them do a good deal of reading but they have not done much that they did not have to, I believe.
28. My class have read widely from many sources, but I cannot say that the quality of the reading has greatly improved.
29. Increased quantity and improved quality.
30. My pupils have never hurt themselves reading, but this term there has been a much more general response and usually with a fairly good comprehension of the subject matter. Many did not find reading material but asked their parents.
31. The librarian reports that many pupils read on the topics in the library period. Before this they looked at pictures, now they begin at once to read on the topics they are studying. All work has been voluntary. Pupils have reported outside reading long after topic was studied. Two boys spent an afternoon at a friend's home recently. They reported that they read about cotton and alfalfa in "Successful Farming." They also saw pictures of dairying machines.
32. There has been less reading. What reading was done was possibly more directed or focused to the problem.
33. The children are making a greater effort to read with comprehension now, in order that they may be able to discuss more understandingly each picture as it comes to us.
34. The film caused more reading to be done and motivated it. An increased amount of purposeful reading is the big result gained in this experiment. Films were verified by reading.
35. I have not been able to do any standardized reading testing but feel that the quality has been improved and I know we have read more than ever before.
36. Through the use of the film the children have done a great deal more of reading. Many times instead of reading just any book from our library, some will get books pertaining to the topic in Geography.
37. The amount of reading has been more than doubled. The children are becoming more interested in informational reading.
38. Yes, I would say very much. They have done more intelligent

reading. Parents report much more interest in reading at home.

39. More reading has been done than ever before.
40. The children have read more both at school and home.
41. Less in each case. Because the film has been the "Headlines" and all was expected from film as an easy method to obtain information.
42. Children have read much more by themselves, have necessarily read more difficult books, although I believe they didn't always understand just everything they read.
43. Pupils have read a great deal more and a greater variety of topics. They also visited the institutions in connection with the film — State Farm Dairy, Milling Company, etc.
44. They have read more reference books from the library, and the girls have read more of the science magazines.
45. The quantity of current articles in newspapers and magazines has been greatly increased. This in turn affected the quality for all articles were the best kind of material in papers and magazines.
46. Pupils have read more and with much greater interest. Much like we read of a locality that we have recently visited. Picture starts a wellspring of interest in everything touching topic.
47. Yes. They read a great deal more with a definite object in view.
48. Encourages them to read more and on a definite topic. They are able to make correct selections.
49. The quantity of reading for facts and information has been greatly increased.
50. Children had reference books at home but hadn't used them much before. If this hadn't been so hurried they would have read more. They brought the books but didn't always get the contents.
51.
52. There is no doubt that the children did much more reading, but, unfortunately, the books used were far beyond their comprehension.
53. From incidents told in class about the dangers of mining or tunneling mountains for water, supported by film illustrations, many of the children came to see that there were just as good stories about these actual facts as about the sensational fiction they read. "Stories of the Great West" by Roosevelt, and

"Wealth of the World's Waste Places" and "Oceania" by Gilson, I found were read.

54. Judging from pupils' reports of reading done, the amount of material passed in, reports given in class, articles brought to my attention, etc., the pupils have been doing much more reading since we began using the films.
55. Increased quantity has also stimulated them to pleasure reading along same lines, so I can also say has increased quality.
56. They have developed research ability to quite a degree in many children. They have brought into active use many sets of books otherwise neglected.
57. Children have contributed almost all the reference books on the various subjects as loans from the Public Library. This wide reading of good material no doubt has broadened their outlook and improved their taste.
58. Magazines, newspapers, pamphlets are perused with the idea of finding information in connection with the film.
59. Yes, pupil's choice of weekly library book is made with reference to some related lesson topic.
60. They have read more, but took a great deal of time to awaken to the fact that it was imperative for them to do so.
61.
62. The school library and the public library have issued far more social studies reading material to my class since we have been having the films. Some ask for this type of material rather than fiction.
63. They read everything about the different topics that they find. I do not think they exert themselves to search for books.
64. It has improved the quality of their reading as now they are reading in the Book of Knowledge, Compton's Pictured Encyclopedia, Wonder World, and Carpenter's Geographical Reading.
65. They read less. Because they don't read textbooks now.
66.
67. The children were anxious to read as much as was possible for them to find. Increase in the number of pupils attending the library regularly.
68. On the part of a few — yes. However, the time was so limited for the amount of material to be learned, to determine the quantity of reading.
69. Considerable interest and desire to read and study more, are

shown. Lack of time and necessity of next topic prevent discussion of material read.

70. There has been a tremendous increase in quantity and betterment in quality of reading. About two thirds of the children brought books from the Public Library. The total number of books brought was over sixty.
71. Cannot tell. Not enough time allowed for films so children could read.
72. The rate of reading increased and the choice of reading improved.
73. The film has affected the quantity but not the quality.
74. Material has been looked up in the library books to some extent. The group is very slow so not as much reading has been done.
75. The children have wanted to read quantities of material but I have had difficulty in finding material simple enough for them (on many topics). They are two years retarded in Reading.
76. Yes, in a negative way, there has been little opportunity in the time allotted.
77. Yes, more time is spent on outside reading, marble, etc., have been brought in as extra work. Notebooks with extra clippings and more than required work have been handed in.
78. It has improved the quality and increased the quantity.
79. Stimulated reading both as to quality and quantity.
80. Children ferreted out books and magazines from shelves at home as well as in the library. Material sometimes quite mature.
81. Some are trying to read books too hard for them. All read more.
82. I find the children doing more purposeful reading. The extra time they have, which is very little, is usually asked for as a reading period.
83. They are more interested in the subject taught.
84. According to our librarian the quantity has more than doubled and the quality is the best we have ever had.
85. Children have done more reading. References were selected by teacher and placed in library. Some reading from World Books, Geographic Magazines, and Encyclopedias were read at home.
86. Answer to Number 2 will answer this question.
87. More reading along certain lines, that have to do with topics taught by film.

Question 4. Has the film stimulated project work or other self-activity of the children?

1. Yes. Booklets made, both classes and individual charts. Planned trip to Bakery — visit, letters of thanks sent to Bakery on return bringing in Language. Trip to John Deere Plough Co. to study more about farming implements.
2. We have had quantities of material for our experimental work, some of the data and exhibits coming from Italy, England, and all over the U.S.A. The children have written to some forty companies for material to aid us.
3. Yes. Children have made trips to dairies, cotton mills, Plow Company, etc. They have made boats, schooners, and carved cows from soap.
4. Yes. Charts and booklets are made, and collections of interest gathered.
5. Yes, the children have made booklets on the different topics, and of their own accord made illustrated notebooks. The pictures could be of great aid in project work if it were not for the limited time. For instance, a child was so interested in this topic of Irrigation that she wanted to make a sand table showing the methods of Irrigation, but, for lack of time to discuss, lost interest in it.
6. The film has stimulated project work. The children collected in many different ways data and illustrations on the topics studied. They have written to many places of great distance asking for Literature and samples. They have spent much time away from school arranging these samples on charts or making booklets.
7. It would have, had we been able to utilize the interest. We were asked not to carry over the picture in such a way as to add to time-giving information. The children have worked up several projects independently.
8. Yes, it has.
9. Yes.
10. Yes.
11. My boys are eager to have a debate on the value of corn compared with that of cotton.
12. Yes.
13.
14.

15. With the brighter ones, but not with the dull ones. I have a slow group and many of them are very passive. If permitted to, I think I could arouse them to considerable enthusiasm.
16. Yes. Slightly more perhaps than regular recitation work would have caused. For example, several tried the experiment to show that atmospheric pressure would collapse a tin can. Several worked with cement and lime, and so forth.
17.
18. Yes. The films stimulated project work and could have been carried on very successfully if the time was not limited.
19. Yes. If this were not an experiment in which we are timed, we could have splendid project work in practically every subject. As it was we were obliged to discourage many things suggested by pupils which were the outcome of the picture and their readings.
20. The film stimulated the "collective instinct" of the pupils; provided material for drafting plays; drawing maps; making charts; and creative handwork.
21. Yes. A schooner, dories, and travel lines; airplane, corn crib, diagrams and charts in art were suggested to illustrate different films.
22. Yes, much that had to be curbed because of lack of time.
23. When we did project work the interest was created through class and pupil initiation. The films have created interest but the time has been too limited for class initiation and self-activity. Time did not permit accomplishment of projects.
24. Yes, in case of glass, air pressure, and a few other instances.
25. Yes, in many ways.
26. No.
27. The air-pressure film and the glass-making film stimulated them to do some of the experiments suggested but no projects were started.
28. Yes, there are several illustrations of this in good pieces of work brought in by my pupils on their own initiative.
29. Yes.
30. No. A large number of my pupils come from homes where outside time is taken up with radio, social functions, etc., others from homes where it is necessary for the children to help outside of schools. Since there was insufficient time for such activities during school time, there was nothing done.
31. Yes. The pupils made book covers and mounted their pictures

and drawings for the books in the General Arts class. Two boys made a flail in this class.

32. No. It could, however, if handled according to *our* way of teaching.
33. Yes. The children are attempting more construction work and more diagrammatic work on their own initiative. Also, I no longer need to suggest their visiting near-by industrial plants. They go eagerly.
34. Project work was stimulated by the film. Dairy project was worked out on the sand table when dairying was studied. Some industrial plants were visited. Time was too limited for much self-activity.
35. Yes, I have had several children who didn't recite or take any interest at all before who now have brought in books, have constructed different things, and have interested themselves generally in the work.
36. Yes. One boy planted some cotton seed. Several pupils tested seed corn. Several visited bakeries while we were studying that topic.
37. We have corn, lima beans, and cotton growing in the room; these were started at home. Children have worked out notebooks, alone.
38. To some extent. Being limited to time, the children didn't have sufficient time to express themselves.
39. Not to any great degree.
40. Nothing other than drawing.
41. No, because project work and self-activity are our hobbies and is a "daring" program while films should be supplementary information.
42. Has stimulated children to find books for themselves on different topics at public libraries. Didn't leave enough time on one subject to have much project work.
43. I have had few projects as the time did not permit.
44. They have reported attempts to carry out many of the projects such as brick-making, grafting, transplanting.
45. Yes. Children have made at home many illustrative objects, and have taken deep interest in making a book containing the pictures and articles brought in. Some experiments were tried, too, such as testing out seed corn.
46. Yes, we have made several illustrated booklets, the work of which motivated English, Reading, and Drawing.

47. Yes, many good charts were made and sand-table projects were worked out.
48. Yes, with use of projects in sand table — and making of charts.
49. The children have been so busy reading and finding pictures that, with working out of other projects in connection with other subjects, there was little time to work out a project stimulated by the film. A few pupils found time to work out something for themselves at home.
50. Not much because of other things demanding project work also.
51.
52. The time allowed for each topic was too short for project work.
53. Many problems correlated with this work were looked up by the pupils and samples of cotton, peat, and corn brought in. But as far as going out of their way to draw maps or diagrams or to suggest a project was concerned, the classes seemed to feel that the film was novelty enough and embraced all this.
54. Yes, but they have done no more projects than they did before we used the films. They were already interested and active in projects, other forms of self-activity, collecting, etc., have increased.
55. Yes.
56. There has not been time enough.
57. Projects grow readily out of almost all the films.
58. Have used project work for a number of years but would say the film adds to result.
59. Yes. The pathways to knowledge are made more easy. The approach and study of other lessons made easier.
60. Self-activity has not been stimulated to a greater extent.
61.
62. The sand tables, the charts, and booklets which have been made this term by the children are marvelous. They reflect a wonderful enthusiasm and interest in the topic concerned.
63. All projects and activities were suggested and directed by myself.
64. Not as much as it would have if the period for each subject had been much longer. The time devoted to each lesson was too short.
65. No. (Note. Most of our children are very poor and of foreign parentage (Portuguese) and have little material at

home. Our school is new and we have as yet a very meagre library and little supplementary material collected.)

66.

67. Yes, children were very interested in collecting and discussing the various subjects.

68. Yes.

69. Yes, very much so. Would that we could use more time to this self-activity in class rather than be tied to set schedule, but this is an experiment.

70. Yes. Children have read and collected material on own incentive. Several children reported that they had tested and planted seed corn at home, because of interest in the topic and desire for self-activity.

71. No time for it. If time allowed I think it would.

72. They brought in pictures, paper clippings, etc.

73. The lack of time has been the great handicap in the use of the film so that any project work which might have been stimulated by the film has had to be omitted. However, if time had permitted, the film offered a wonderful opportunity for self-activity.

74. Yes, in the making of charts and exhibits of illustrative material.

75. There has been stimulated much self-activity such as the testing of corn seeds, the planting of cotton seeds, the drawing of pictures on board, visiting the Baking Co. and Gas & Electric Co. (Coke).

76. Yes, many of the simple experiments have been tried out at home where materials were available.

77. Yes, special exhibits of glass making, marble, etc., have been brought in as extra work. Notebooks with extra clippings and more than required work have been handed in.

78. Pupils are making better use of their leisure time in profitable activities.

79. Yes. Visiting local concerns, collecting pictures, making maps showing regions of various productions, writing imaginary visits to places studied, etc.

80. Several boys of their own initiative made drawings and brought them for me to see. Time spent on each subject was too short for much project work.

81. Yes. Some make machinery of wood at home, some draw maps. Other experiments, planting corn, etc.

82. Because of limited time we have not been able to do much of this work but we have kept a list of the posters and exhibits we want to make when the experiment is over. Some boys have made models outside of school.
83. Yes.
84. Yes, I have never had as much volunteer work from pupils before. This work includes posters, original drawings, construction of disk harrow, searches through old books for pictures, all home work.
85. Yes, some films have, but not all of them.
86. I have seen no evidence of such as nothing of its kind has come to me.
87. Yes. Many drawings were made in an effort to illustrate certain things or scenes shown.

Question 5. Did the advance announcement that a film would be shown stimulate pupils to read about the film topic before the film was shown?

1. Yes. I have had children say, "Miss Brown, I am going to the library this P.M. to return a book. What is our next picture? I want to know what else to get." Some are still reading on some past topics.
2. Each class took keen delight in the fact that we were to have our subject ably assisted in its presentation by the use of pictures and when the title of the work was given they used the library freely.
3. As a rule I did not announce subjects until day of showing. On one occasion I mentioned that the next film would show cowboys. Several pictures were then brought.
4. To a certain extent, but the greatest increase was shown following the showing of films — the type of experience being more concrete.
5. Not at first, but toward the last the children asked me, before the picture they were then seeing was finished, what the next one would be and some brought pictures and read about it.
6. The children would ask before a topic was shown the name of the topic, in order to get information on that subject.
7. We were definitely asked not to announce the film in advance.
8. The advance announcement created great interest. We did not give them the topic in advance, though they did ask for it.

9. Did not announce ahead of time.
10. Did not announce in advance.
11. They sent ahead to the U.S. Government to get bulletins.
12. Yes.
13.
14.
15. I did not make an advance announcement that a film would be shown, as I understood that we were *not* to do this.
16. No, I think not.
17. No.
18. Exhibits and reading material were brought many days before the film was shown. Many children would rather read on the topic to be shown than have recreational reading.
19. Yes. Children brought reading material ahead and even drew pictures before the film was shown. (For the first few pictures I did not tell ahead as I didn't know we were allowed to do so.)
20. I was under the impression that a new film topic was not to be announced until the previous topic had been completed. The children were not told what the new topic was to be until it was motivated in class.
21. Yes. Several made comments about reading in advance.
22. The children have always asked ahead what the next subject would be. Until the last two films I did not tell them. When I did tell, they brought material on the topic, and told me of some things they read.
23. As an experiment I felt it was best to make the approach as indicated by the guide.
24. Yes, I have record of several cases of this.
25. Not in any noticeable degree. "Too busy."
26.
27. No.
28. No. The children had little or no time to read about a topic before the showing of the film.
29. Yes.
30. Only with one or two of the very best pupils. I announced the film ahead, but did not urge the reading.
31. No. The pupils were so busy with the topic they were studying that they had no time to do advanced work. The pupils would have liked more time on each unit.
32. I am not inclined to believe that it did.
33. I do not announce the taking up of a new subject ahead of

time as I like to make a well-planned approach to each new topic, so no advance reading was done.

34. Children responded to the advance announcement and brought in illustrative material including books, pictures, clippings, and samples of material.
35. As I did not make an advance announcement that a film would be shown, the pupils did not read about the film topic beforehand.
36. Yes. I usually assigned the reports beforehand and many brought in material even before the film was shown. Some would ask what the next topic was going to be before we finished one. Some wanted to know so they could get library books.
37. Yes. If they were not told they would ask so that they could begin to read about the new topic.
38. Yes, it stimulated a large per cent of the pupils.
39. Yes, they were very anxious to find out about it before film was shown.
40. I didn't give an advance announcement.
41. No, as films are not new with us, but have used them before at regular intervals — 2 each five-week term.
42. I did not announce the films in advance except iron. Children naturally read about iron while reading about coal.
43. Yes.
44. Not during this experiment as they were busy reading on one film when we were hurried to the next and they could not keep up.
45. In a few cases. It did stimulate the collecting of papers, books, and magazines for the new film. Many children saved room on their library cards for books relating to topics to be studied.
46. Yes, in many cases pupils brought in books on topics previous to the lesson.
47. Yes. Often material was brought in before the film was shown.
48. Yes, in the showing of later films more advanced reading was done.
49. Yes.
50. No, they were busy finishing up the old and didn't have much time — they always wanted to know what was coming next, however.
51.

52. Yes.
53. I am afraid the pupils depended too much on getting all their information from the film and so neglected any advance preparation. I tried to counteract this condition by taking time before the showing of the film to point out facts and relationships between points in the "General Survey" that would lead to a clearer understanding of the film.
54. Pupils did most of their reading after seeing the film.
55. Yes, and many pictures and models were brought in even before the showing.
56. Yes, when the research for one topic brought to attention material on another.
57. Children beg ahead of time to know what film will come next, that they may look up facts and information and be ready with reference books at the first lesson.
58. Yes, to a great extent.
59. Yes. Some pupils had collected materials before the film work was shown, showing preparation.
60. In some cases, yes — in the majority, no.
61.
62. Yes, decidedly so. Many secured books and material on the topic weeks ahead of time.
63. Always, on the first day of the films, the children had pictures and books.
64. No, it did not prove so in this school.
65. No. Only one or two in the brightest class make any effort to read on a topic outside of class.
66.
67. Yes, often we had a list of four or five books and collection of several articles in connection with topic.
68. No advance announcement was made.
69. Some reading was done ahead but lack of time prevented much. Each new topic brought added interest.
70. Children asked several times what the next film was to be so that they might get library books. These books and pictures were often brought in advance of pictures.
71. I did not announce films in advance.
72. No. They brought in material but they did not read about it in advance.
73. Yes.
74. No. The group I have worked with are very slow, some of them subnormal.

75. I am sorry I did not announce the film in advance but led up to it through things which were known to the children just before it was presented as a whole.
76. No, advance announcement was not given of the film.
77. Yes. Pupils were anxious to secure pamphlets in advance of the film in order to know what the new film was to be.
78. In some cases I found this to be true.
79. Not usually, for they were busy with the subject of the week as per (2) time limit objection.
80. Had more interest shown in film after first discussing the subject. The films made clear what words could not, and words made clear what films could not.
81. Yes. Some brought pieces of coal, pictures, and so forth, long before they saw the picture.
82. There was no time for this reading.
83. Not particularly, because they did not have time to do everything wanted done.
84. I did not make advance announcements.
85. No, there was such a little time given for each film the children would hardly finish reading about one film before another was shown.
86. No, but I should not say it was the fault of the film or the lesson plan; the group as a whole is very slow and very dependent on teacher's supplementary work.
87. I am not sure that it did.

Question 6. Does the film stimulate a greater desire on the part of the children to write on some of the topics covered by the film or to discuss these topics?

1. It seems to me to stimulate a greater desire on the part of my children to discuss the topics. At the beginning they wrote a number of papers on topics and because of lack of time I could not hear them all read.
2. I have not had the least bit of trouble in getting each student to do any of the work assigned. On the other hand, I have had more topics written up for discussion than we have had time to use.
3. All the pupils wish to discuss every topic. The desire to write about the topics has increased slightly.
4. They were more eager for oral discussions. They seemed to

feel they knew more and could tell more in talking than in writing.

5. The film surely stimulated a desire to discuss the topic, and to such an extent, it was hard to curb this desire so as to have other work. The time limit was also a hindrance in this as it prevented the teacher from hearing the discussions and thus causing the children to lose interest.
6. They were extremely anxious to get a report on a certain topic. They were disappointed when no opportunity could be given to hearing and discussing these topics. Some continued to get reports for their notebook until the last topic was shown.
7. Yes. Again lack of time was a serious handicap.
8. They enjoy writing and talking about the things they have "seen."
9. Yes.
10. It stimulated the desire to discuss these topics.
11. They have written on many of the topics and they want to give a program in the Assembly Hall.
12. Yes.
13.
14.
15. Yes, but we have done very little writing, as it was not permitted at first. The children have discussed the films a great deal with each other at home.
16. The film does stimulate a greater desire on the part of the children to discuss the topics. As to writing, I don't believe it does.
17. Yes.
18. In the English period I had difficulty in teaching the "required work" as the children wanted to write on the particular phases that interested them. The improvement in sentence structure was very good. (It seems easier to discuss than to write. The written work does not show the knowledge the children have of the films.)
19. Yes — more particularly to discuss than to write on them. Oral discussion of the subject shows up their knowledge to far better ability than their written work on the subject.
20. The films have been extremely helpful and decidedly advantageous in providing material for composition work. The children are very much interested in writing letters to pupils who have been absent from school and explaining the films to

them. The letters and compositions contain much worth-while information. The children are keenly interested in discussing the films at home.

21. Yes, a real desire to talk and write on some of the topics — this manifests itself in the English class especially.
22. The films have stimulated my class to discuss the topics. In their written work they frequently mention having the moving pictures, and tell how they enjoy them, especially in letter-writing.
23. I think it did stimulate to write on topics but we adhered closely to the thirty minutes of teaching and for the first three weeks did not correlate this with the English for fear of disturbing the thirty-minute teaching schedule. Some children, however, did bring in written material.
24. Yes, I think it stimulates greater interest for both writing and discussion.
25. It does, and their discussions are sane.
26. Children show a real desire to write upon and discuss topics presented by film.
27. Yes.
28. It does on the part of my brighter pupils, but I failed to see any difference on the part of my lazy or slow pupils.
29. Yes, English teacher has told me that the pupils have chosen film topics for their compositions in preference to those suggested by her.
30. My classes are usually ready to discuss, but more associations are recalled by films. After the first four units the children were given about ten minutes each day to write discussions in their notebooks. Often they would come into the classroom and ask if they could write in their notebooks.
31. Yes. A part of the literature work each year is to write reports on their social science topics. The report received from the literature teacher is, that several ask every day, "May I write a science report?" Also that the pupils are so interested in this work that they do not want to do their other work. Some of these reports are to be published in our school paper.
32. Yes. It was a great help to discussion. It brought the teacher and pupil to a discussion of activity, a situation which both saw. There is less writing when the film is used.
33. The children in this group write poorly as they are a retarded

group, mostly of foreign parentage, but they are enlarging their vocabulary more rapidly and they enjoy discussing the topics both formally and during their free periods.

34. Children were more interested to discuss topics than they were to write about them. Very little desire was expressed to write on the topics.
35. Yes, we have had some very good written compositions in our language work on topics used in the films and outlines. Children were very anxious to have theirs read and put on display.
36. It seems to stimulate them more in being able to make diagrams, and in discussions.
37. It is hard to bring a discussion lesson to a close — the children have become so interested in topics studied. They have asked for pictures of other industries.
38. To some extent, because material is more vivid. They each have some information without much effort on their part.
39. To discuss these topics.
40. They greatly enjoyed discussing parts of them. Some were not so interesting.
41. No — for reason above given.
42. Stimulated desire of pupils to write what they had read, and read to class. After this they did wish to discuss these matters a little, but not enough.
43. Discussion is always the greater. They do not care to write.
44. They do not seem to desire to write but are most anxious to talk about the topics.
45. The desire to write and discuss topics has always been great in our school. I can't say the desire was any greater to write, but it was to discuss orally.
46. It stimulates both. We wrote booklets, each pupil contributing a topic. Nothing but the gong to close ever stopped them from discussion.
47. Yes.
48. Yes.
49. The film stimulated a greater desire on the part of the children to discuss these topics.
50. It stimulated a desire to discuss the topic in the case of some who had never volunteered before. They were more dilatory when it came to writing.
51.
52. I noticed that they preferred oral discussions, thereby getting

different ideas told in such a way as to be easily understood.

53. In their health work, the children were eager with their information about pasteurization and seemed to have the film material foremost in their minds.
54. Yes — particularly in regard to the five topics enumerated under No. 1 above.
55. Yes.
56.
57. My children prefer to discuss the film than to write about it. They have written letters explaining experiment and have stated repeatedly that they have learned more this way than by textbook study or still pictures.
58. Children are very anxious to write on that part of the film that interests them, not on all parts.
59. Most pupils preferred to discuss the topic matter but pupils preferred to write on the topic matter rather than to have a regular Home Lesson in daily work assigned.
60. Discussion yes, writing no.
61.
62. Yes. Often a child has seen something in the film that was of especial interest to him. I permit him to write and do research work on the phase that interests him greatest.
63. Yes. Yesterday we had a very stirring debate on the relative usefulness of coal and iron to man.
64. Essay type examination at the end of each film lesson is very difficult for the children as they lack facility in vocabulary and in English expression. I find that the pupils can discuss topics better than they write.
65. I cannot say.
66.
67. Yes. Many of children were able to tell some story of an incident or make a written report.
68. Yes, on the part of the majority of the class.
69. Yes. So many points are clarified by pictures that children understand and are willing to do.
70. Yes. Children were especially desirous of discussing topics related to the film both during and outside of the class period.
71. Yes.
72. Yes; also they were able to describe a thing more vividly and accurately.

73. I think not to any great extent.
74. With some of the brighter pupils, yes.
75. My children are unable to express themselves in writing, but they did like to discuss the topics covered by the film. I was often amazed at the knowledge which they seemed to have.
76. There were a few who liked to write up on topics. Most were keen to discuss them.
77. Yes. Special reports, and outside excursions on the film topic stimulate reports and discussions.
78. My group were interested in discussing these topics. They are too badly handicapped in writing to use that mode of expression.
79. Yes, decidedly. The class newspaper was greatly improved.
80. Yes, and it also increased their ability to do so. They were interested in finding words to express their thoughts.
81. Like to discuss.
82. Yes, we would take much more time discussing some current phase of a subject already past, if we had time. Newspapers mean more to the class.
83. Yes.
84. Yes.
85. Yes, and enough time is not given for children to discuss them as much as they would like.
86. I say yes, though even at that, the desire is not keen.
87. It does.

Question 7. Does the use of the film cause the children to correlate features of the film with local conditions or personal experience?

1. Yes.
2. They have been asked to make comparisons and to correlate the facts of the film with their everyday life. This feature of the experiment has assisted greatly to keep their interest stimulated all the while.
3. Yes. Many who have lived on farms were able to tell experiences.
4. Yes, comparisons of similar undertakings in our community, our State, within the experience of the pupils.
5. Yes, one little girl, who had lived in California, told the class many interesting things about irrigation in California. An-

other child, whose father worked in an iron mine, helped the children with some points in the picture which they did not understand.

6. Topics on activities far away were correlated with activities near at hand. The Wisconsin Dairy farms and dairies were compared with those of our own State. Wheat farms in the Dakotas were compared with the Georgia farms. Some of the activities shown in the pictures were very vivid to the children as they had participated in similar activities.
7. Yes, decidedly.
8. Very much more than I have ever secured in any other way.
9. Yes.
10. Yes.
11. Yes, they talk about the grain elevators around Chicago, etc.
12. Yes.
13.
14.
15. Yes; in the wheat, dairy, irrigation, and other films that the children were familiar with, there was a marked tendency to make use of personal and family experiences. Many children of their own initiative visited a local bakery, some a dairy.
16. Yes, very much. This part could be developed a great deal.
17. Yes, very decidedly.
18. Many times correlation was made between the features taught by the films and the reading lessons. Time and again children referred to the film to answer a real problem.
19. Yes; to illustrate: When wheat, corn, cattle, and so forth were given, the class was very eager to tell of their experiences either on their own farms or when they visited. I mean experiences that definitely related to the film or reading that they had had. One child suggested our going to a local bakery.
20. The subjects treated in the films have stimulated the children to recall their own experiences, make comparison with local conditions, and have instilled a desire to learn more about these things.
21. Yes.
22. Yes, in the case of every film this has been true. Some boys told how they had milked, helped with farm machinery, etc. They told how they had seen rodeos, about the neighborhood bakeries, etc.
23. In all cases, as with the dairy, cattle, and irrigation films,

where the subject presented was not a remote foreign thing to the pupil, they correlated.

24. Yes.
25. It does, for it makes them recall what they already have seen and know.
26. Yes, it does. Different children have different backgrounds of experience which are very useful.
27. Yes.
28. Yes, there were many illustrations of this in their talks and the special work they handed to me.
29. Yes.
30. Yes. For every unit, unless perhaps the N.Y. Water Supply, some features were correlated to their past experiences. This was very general in low groups as well as high groups.
31. It does. After seeing in the film where the red hot coke is pushed out at Mr. Ford's coke plant. Three boys' fathers had worked in a Pennsylvania coal mine. The pupils often correlated one part of a film with another in a new film. Example — Coal is taken to the top of the mine tipple, like the wheat taken to the top of the mill.
32. Yes, very much.
33. Yes. Daily we find these correlations, each time more readily than before. Especially was this true in the flour milling and dairying pictures.
34. Children correlate the films with their personal experiences more than local conditions. Pictures give the children a more meaningful conception of the industries.
35. Yes. We have found a great many places in which to correlate features of the film with personal and local experience, flour mills, dairying, etc.
36. Yes. They told of a steam shovel being used in some part of Kansas City while we were studying "Iron Ore to Pig Iron." Many related experiences with wheat fields, coal mines, flour mills, bakeries, etc.
37. Yes. Children have been able to clear many points because they have visited various industries while away during the summer.
38. They correlate features of the film with personal experiences more than with local conditions.
39. Yes, visits to iron mines have started.
40. Yes, many of the children related personal experiences, especially about farm life and work in the bakery.

41. They help and have their places.
42. It certainly does cause them to correlate film with personal experiences, especially mining, cattle raising, and cotton. This is not so true of local conditions. These subjects really didn't have much to do with local conditions in Kansas City.
43. Yes.
44. Many such reports have come in.
45. Yes. This was evident time after time. When "Irrigation" was the topic several children brought in the illustrated article on "What's the Matter with Nebraska." This article told of the floods and water waste which could be avoided by dams and irrigation.
46. Yes. They did not compare local conditions themselves, but when questioned, immediately enthusiasm was at its highest. All kinds of ranching, cotton growing, and coal mine experiences of their own and their fathers came in.
47. Yes.
48. Yes.
49. Yes.
50. Yes, in general. They were curious to prove and see for themselves — they made several visits around town and country.
51.
52. I had several children whose fathers are in the cotton, leather, and coal business. They aroused great interest in the classroom by discussions and material brought in.
53. Since we had several colored children in our class we had the advantage of knowledge gained through actual experience in the cotton fields; others whose fathers had worked in mines gave us interesting information on the mining subjects. In discussing the conditions necessary to the making of peat, lignite, and coal, we found that our local conditions would allow peat making and actually had some peat brought to school.
54. The pupils did correlate, to quite a satisfying extent, the features of the film with local conditions or personal experience.
55. Yes.
56. Yes, to a marked degree.
57. This is one of the happiest features of the work. Children have to correlate their personal experiences on farm, in use of products at home, or in securing them from dealers.

58. Yes — but the film in many cases is too scientific for the ten-year-old child.
59. Yes. Many pupils had or have relatives connected with the work described in the topic subjects. Many surprising and wonderful experiences were related. (One pupil visited coal mine Number 3 in Virginia.)
60. Yes.
61.
62. Yes.
63. Yes. Many personal stories were told while discussing films.
64. That is the case in regard to the latter films. It was the lack of experience and mode of thinking in the first films that prevented this correlation. For many of them it was difficult, as they had nothing in (doesn't seem to be finished).
65. Yes. But whether more than in ordinary classes I do not know.
66.
67. Yes, very much information was gained from what they had seen or were told by parents. Two of the children related story told by father who had been in coal mines.
68. Yes.
69. Many times children will tell about machinery they have seen on places where they have been that have analogous points.
70. Yes, as far as possible. Ex.: Interests in bakeries near by and in home baking; also in use of coal in homes and factories; children also compared machinery with machinery they had seen.
71. Yes.
72. Yes. The film seemed to be the "self-starter" which many of the children needed.
73. Not to any great extent.
74. Yes.
75. Yes. This, I feel, is one of the things in which the film excels. Children who have little to say as a rule wanted to relate their experiences, inspired by the film.
76. Yes, as well as first term seventh grade children can.
77. Yes. Pupils were anxious to relate personal experiences, particularly in Reforestation and Planting of Trees.
78. I have found that they did.
79. Yes, and resulted in many visits to local factories, etc.
80. Many of the children interested their parents to such an extent that the parents went with them to visit local plants.

81. Both.
82. Yes.
83. Yes.
84. Yes, especially the farm pictures. Many of my boys and some girls have done farm work. They showed great interest, brought in small implements they had used. They were interested in improved methods, machinery, etc.
85. Yes, children are always wanting to tell of their experiences.
86. Yes.
87. Yes.

Question 8. Does the use of the film increase the richness, accuracy, and meaningfulness of experience and imagery?

1. Yes, they notice and ask questions about things that I probably haven't noticed.
2. The experiment has done all you ask and more. Each class has been a great question mark during the entire experiment; wonderful results.
3. Yes.
4. Yes, a concrete type of experience that gives vividness that cannot be obtained from the printed page is found by use of the film.
5. Yes, one day I saw a little girl working industriously at something apart from what the class was doing and discovered that she was drawing pictures of parts of pictures she had seen. Every day children bring to me pictures they have drawn of boats, shaft mines, blast furnaces, and maps of sections they have studied.
6. The use of the Guide promotes a systematic method of study. A vital motive or problem is given for each lesson. The information needed is at hand to get the answer. If we were permitted we might get from each topic a motive for every Reading, Language, Spelling, and in many cases the Arithmetic and History lesson.
7. Yes. I believe if the film could take its natural place in teaching any topic as an aid in presenting instead of the limited use we have been able to make of it, it would be invaluable.
8. Surely, because it visualizes for them.
9. Yes.

10. Yes.
11. Indeed it does. They have learned many new words.
12. Yes.
13.
14.
15. Yes, I feel sure that the child gets clearer information in many ways than he would get from reading. Many things that are difficult to understand on the printed page are made clear in the film.
16. I think so. Of course the pictures themselves will and can be improved upon.
17. I do not know.
18. Yes. The children have been taught to observe more accurately the details of pictures.
19. Yes. The discussions, also the drawings, show me that they are observing pictures in books more accurately in their relation to the film, also that they read more accurately in relation to the film.
20. Decidedly so. I noticed quite an improvement in the children's vocabulary and ability in expressing their ideas.
21. Yes, indeed.
22. Yes.
23. There is no doubt in my mind but that it did. However, the sixth grade child was often handicapped in getting this enriched comprehension due to the fact that many words and phrases were too difficult.
24. Yes, undoubtedly.
25. Yes.
26. Yes. I feel that it does to a great extent. It makes for a reality of experience that is difficult with reading only.
27. Yes.
28. Very much, but I feel the film should be more carefully explained to the pupils by the teacher, at the moment of showing.
29. There is no doubt about it, especially group.
30. Yes, very much so. It is hard for pupils to create visual images by word impressions when there can be few comparisons. By films both visual and verbal can be given, thus enriching and making more accurate and real the experiences. I think their drawings show this.
31. Yes. The home teachers report that in the supervised study period the pupils show they have a better command of language

as related to industries. The pupils use the knowledge obtained from the film. A home room teacher told the class about her visit to a coal mine. One boy said, "We did not see any mules in the mine." When the class came to their recitation class I was asked "if mules were used in coal mines." Pupils use drawings to illustrate points from the film.

32. Yes. Much more so.
33. Yes, children get a much more concise conception of processes through the picture than through the printed word which conveys little to this group.
34. Mental picture is more lasting and richer than one that a child would obtain from a printed page. Representation is accurate.
35. Yes, as these children get very little from reading. They get a clearer, more concise idea of processes through the films.
36. Yes. The pupils seem to be able to express themselves better, both orally and in writing.
37. Yes. It has made industries *real* to children.
38. Yes. Very much.
39. Children talk and write with more accuracy and richness.
40. The use of the film gives a much clearer idea of the work they are trying to get.
41. Can't see it that it does more than make things more visual.
42. Yes, undoubtedly, children can really know what different things are like.
43. Yes.
44. Decidedly so.
45. Yes. I noticed the children improved in "seeing" pictures. I believe learning this way is a method that improves with use. The films seem to be more easily understood as time went by.
46. It certainly does. It's the very next to visiting the real industries. One pupil said, "It just seems like I really have been there myself."
47. Yes.
48. Yes.
49. Yes.
50. It has helped many to express themselves better.
51.
52. The children who read a topic before seeing the film had questions about the different processes. Most of these questions were answered by the film.
53. The animated maps and diagrams were especially helpful in

furnishing vivid, self-explaining impressions. The main difficulty was in having the children transform these images into words, without using their hands or the expression "something like this."

54. Yes. Herein lies one of the greatest values of the film.
55. Yes.
56. Yes. However, because of the time limitations necessary for the experiment, proper drill for location, etc., could not be given.
57. In no other way could the children so clearly get the motive of the dependence of man upon man, or comprehend so keenly the dignity and necessity of labor.
58. Immensely, only thing missing is the color and lack of human interest.
59. Yes. It supplements the ideas — experiences, of many of the subjects under consideration. Our principal was surprised to find the pupils anxious and pleased to have their tests.
60. Yes, very much indeed.
61.
62. Yes. One child wrote an article for the school newspaper about our work with moving pictures as a part of our social studies work. She says, "I like having the films because the pictures help me to see clearly and understand things better than I could by just reading about them."
63. Yes, I think it does.
64. It does and we find that a number of children are thinking about this material that children of other classes did not think about it.
65. In my opinion, yes.
66.
67. Yes.
68. Yes.
69. Yes, it ties together so many loose ends seen here and there. Pupils can see action and action means clarity and accuracy. Such a large percentage are visual minded.
70. Children seem to have much clearer understanding of the subject through this work than would otherwise be possible. As the work proceeded, advantages of this experience seemed more evident.
71. Yes.
72. Yes, and it gives them more self-confidence in speech.
73. Very greatly.

74. Yes.
75. Yes. Still I feel that the experiment is too near us to be able to answer this wisely, now.
76. Yes, and it would to a greater extent under normal teaching conditions.
77. Yes.
78. It does to a large degree.
79. Yes.
80. Yes, not only of pupils but the teachers.
81. Yes.
82. Very decidedly.
83. Yes.
84. Yes, as far as I can judge.
85. Yes.
86. Some parts of the film, though some are very vague and indefinite.
87.

Question 9. Does the use of the film and the guide enable you to organize more comprehensively and easily the material for recitations?

1. Yes, I like them very much and am planning to preserve mine, as I think it a most valuable outline.
2. The study guide has helped to organize the work but it is too extensive in its scope, due to a lack of time; aside from that, it is all O.K. The film is organization personified.
3. Yes.
4. Yes — it relieves the teacher from preparing the Lesson Plans — thereby giving more time for teaching.
5. Yes, I find the film and guide an excellent aid. I should like for some of the films to go deeper into the subject, for instance, the picture on Cattle. After that film the children were disappointed because they did not see what became of the cows after they were carried on the train.
6. The use of the guide promotes a systematic method of study. A vital motive or problem is given for each lesson. The information needed is at hand to get the answer. If we were permitted we might get from each topic a motive for every Reading, Language, Spelling, and in many cases the Arithmetic and History lesson.

7. Yes.
8. Yes.
9. Yes.
10. Yes.
11. The guides are excellent. They have evidently been prepared by experts.
12. Yes.
13.
14.
15. I think the material in the study guide is well organized and it is a great help to have it. However, the amount of material is entirely too great for so short a time.
16. I believe the classes taught with the pictures were more difficult to teach and "get across" to the pupils than regular recitation work. Of course, teaching with pictures was entirely new to me. This is my second year teaching also. It is easier now and I believe I am doing a better job. But with no examination papers to grade, I do not know just how much *teaching* I have really done.
17. Yes, but time did not allow full development of any of the topics.
18. The amount of material in the guide is too great for the time allowed. The vocabulary used is too difficult for the children. The organization in the guide was helpful.
19. Yes. However, the pamphlet has so much material that it cannot be covered in the time given. The vocabulary is too difficult, but the organization helps wonderfully.
20. Since lessons should be planned around well-selected central topics with an abundance of visual and concrete material, I feel that I can better organize material for recitation with the use of the film. The advantage of the films is that the lessons are organized in reference to a basal line of thought and then into well-ordered series of outstanding points.
21. By all means. The study guides would be splendid even without the film.
22. Yes. It has helped me especially in organization, though I feel that the guide covers too much material for the allotment of time.
23. Yes. A great deal of credit goes to the logical organization of the material.
24. Yes, this is some help.

25. I think so.
26. Yes. The work is well outlined and easy to follow and organize.
27. Yes.
28. The guide was of very great aid to me. I only wish I had had enough time to teach it and to explain and go into the subject as the guide book outlined. My upper grade children needed time for vocabulary drills and more careful teaching than I could begin to give them. I was too rushed to do any topic justice.
29. Yes.
30. Yes, but I like the opportunity of individualizing the subject matter even if it is more work. For the experiment these were necessary but for the regular classroom work I would prefer to have the general outline and have the details filled in by the teacher.
31. It does. The sequence used in the film and guide book enabled the pupils to summarize the topics and sub-topics, in outline form. This outline was very valuable as a guide to oral and written work. (A suggestion — number the pages of the guide book, please.)
32. The use of the film without the guide would be more satisfactory for me. More explanatory and descriptive material would be valuable if brought down to the level of pupils of this age.
33. The guide has been a great help in indicating a general trend of thought and has given some information which I have never found elsewhere.
34. The guide and the film form the basis upon which I could make a detailed outline for class use.
35. Yes, very much. In most cases the guides were concise and to the point. However, a film necessarily would have to cut out some of the subject matter one would teach.
36. Yes. The study guide helps the children also to organize their material better.
37. It is a great help.
38. Yes.
39. It is a great help to the teacher in organizing the material to be taught.
40. Yes, decidedly.
41. No.

42. No. I find that children do not find interest in discussing film as outlined in their "Study Guides" and in the "Teachers Guide." It seems to me to be better to let them organize own material instead of giving them the organization and letting them discuss it. They would be more interested if they did it all themselves.
43. Yes. I consider the lesson plans most excellent and very helpful.
44. Not during this hurried experiment but see great possibilities in using them in regular work.
45. It certainly did. The guides were splendid and well planned. I could not have taught the films without the guides.
46. They gave us such a logical sequence all we needed was more time to follow your work. We went too fast to do half what we wanted to do.
47. Yes.
48. Yes.
49. Yes.
50. Yes, it was well planned for my purpose. The children's leaflets were a little difficult for 9–10 year olds.
51.
52. Lessons are more easily planned and without doubt more distinct.
53. The division of the work into film units and the organization as planned by the guides was very practicable. Often the order of the work changed according to the trend of the class discussion and sometimes a different approach was used with certain groups, but I think the work actually accomplished compared very closely with the given outline.
54. Yes, but the time given to a topic was too short; this is especially true with regard to the first five films.
55. Yes.
56. Yes.
57. The film and guide so accurately and comprehensively dovetail that it makes the preparation of lesson simple, delightful, and logical.
58. The guide is almost useless to a ten-year-old child — vocabulary too difficult — too much advanced.
59. Yes. Gradual development of the subject matter made easy the research work.
60. Not necessarily. (The language in guide for children is much too difficult.)

61.
62. Yes.
63. Very decidedly so.
64. Yes, and it gives a point of departure for the discussion and enjoyment of the material in a meaningful way.
65. Yes.
66.
67. Yes, very helpful.
68. Yes.
69. I can readily see for the sake of experimental accuracy how each teacher should teach very closely to the accompanying guide. To me, in this experiment the film is the end rather than the means to that end. For eighth grade General Science, I believe that there was too much detail expected in the outlines. The general features should be few and well emphasized. In regular teaching I would organize my work considerably differently. The films are fine and are well worked out and planned. Several technical errors are still in them. They have helped me immensely for progress requires various points of view.
70. Yes, the work is definitely organized and easily developed from the guide and film.
71. For these particular ones. Does not aid in general. Study guides far too advanced for children.
72. Yes — I found them both most complete.
73. The film and guide have been very helpful in organizing, though in some instances it has been difficult to find books dealing with subject matter within range of child. I refer especially to film on Irrigation.
74. Yes.
75. Yes. The guide was splendidly worked out and was a great aid to the teacher in organizing and preparing the material for recitation. The use of the film is unquestionable.
76. Yes.
77. Yes, but more time should be given to each film unit in order to have more outside reading and project work.
78. It has been a most dependable prop. I think teachers have gleaned as much as pupils from the project.
79. Yes.
80. Yes, but I felt that in some cases it was too advanced for a class with the caliber which mine possesses. My class is composed of a majority of girls with flighty natures.

81. The film does, but guide can be improved upon.
82. In some cases it did and in others I should have preferred to have made my own organization.
83. But I would like to see better guides provided.
84. Yes.
85. Yes.
86. Yes.
87. Yes.

Question 10. Do you get more pleasure out of teaching and are you able to stimulate greater self-activity and originality in the children with the use of the film than without it?

1. Yes, it is hard to tell which has enjoyed the teaching with the film most, teacher or pupils.
2. In the past ten years of my teaching experience, I have never enjoyed my work as I have doing this experiment. It has given me new vision of the possibilities incorporated in just such work and I would never be without the aid of the films in my teaching if it is humanly possible to have them. The teachers of my department feel the same way about the situation. Several other teachers of different departments have asked me how they could secure such aid to develop their subjects. Long live the work of this kind.
3. Yes. The class which I now teach is a very slow group. Before the experiment it was very difficult to stimulate any self-activity.
4. Yes, the lessons are more carefully planned, and assignments and suggestions are better organized than one teacher could do. References to see supplied.
5. Yes, far more.
6.
7. The use of the film would be a great advantage. We have hardly given it a fair test in this experiment, as time limit to the series of lessons and the daily lesson has only served to arouse children. We have not been able to make use of their desire for activity.
8. Very much.
9. Yes.
10. Yes.
11. I enjoy the teaching with films much more than with textbooks only.

12. Yes. We are sorry to learn this is the last film.
13.
14.
15. Yes. If I felt free to teach the film as I should like to do, I feel that my group would get a great deal more from it. Since this is an experiment, I understood that the teacher was to be more or less passive, but I think the film needs *teaching*; I do not think it will teach itself.
16. I can't say that I derived any more pleasure from teaching with the film than I did in regular classroom work. I do believe that the pictures, brought in occasionally in line with certain topics, would be a wonderful help. If the pictures were made to fit a course of study instead of the course of study made to fit the picture, I believe the pictures would be a greater help. There seems to be great possibilities in the future of pictures as an aid to teaching. But they should be only an *aid* to the regular classroom work.
17. Yes.
18. I have gotten more pleasure out of teaching and was able to stimulate greater self-activity and originality in the children with the use of the film. It has been the means of helping me to enjoy my teaching very much. I only hope that this will be the beginning and not the end of teaching geography by means of films.
19. Yes, the class and teacher look forward to that period with great pleasure. I surely hope (and the children heartily agree) that we shall continue to study social science with the vitalizing aid of the film.
20. The abundance of rich material given in the films along with the supplementary reading provide the stimulating thought material for children. I feel that I am going to miss the use of the films when this experiment closes. I appreciate the opportunity of having worked with them and feel that my own teaching experience has been broadened.
21. Yes, wish all teachers of Geography could have had this opportunity.
22. Yes, I am very enthusiastic over the use of the film in teaching. I have enjoyed it as much as the children. I should like to feel free to correlate the film more freely with other subjects. It could thus be made a source of greater self-activity and project work.

23. Yes, but I would not want to be so limited by the use of the films, that I could not carry out project work. I am convinced that visual education has great possibilities and aids teaching but that visual education cannot be the teaching instrument itself. If it were possible to use the films as an *aid* and still have the time for self-activity and initiation, I think we would have an ideal situation.
24. Yes, I think it is a good aid in teaching. But really believe that it should be supplementary rather than the care of the teaching material.
25. Surely, I like it myself.
26. Yes.
27. I have enjoyed teaching with the film since the time for each has been lengthened, since so much more of the topic can be covered. I don't think that with our children there has been any greater self-activity and originality since they are constantly encouraged in these anyway.
28. I most certainly enjoyed teaching these topics with the aid of the films and booklets and look forward to having such films for most of my social science work in the near future. However, I hope to be given a larger margin in time and more freedom in using my own methods of teaching. I am positive that the use of such films in my social science classes will stimulate both teacher and pupils to better work in every way, as well as put a zest into the lessons. I am sure that these films will prove great time savers in the learning processes.
29. Most decidedly so.
30. Yes. With more time and without the limited scope of the subject matter the self-activities, originality and pleasure of teaching would be increased. This was shown in the *many* and varied responses to films, thoughts not included or immediately suggested in the film.
31. Yes, I feel that the children are more alert to what is going on in the world, especially if a reference to a unit which they have studied is made. There are more questions asked to the "why" now than at first and the pupils discuss more fully any points that arise. The interest of the majority is not now so much in the film but in what they can learn from the film.
32. Yes and no. I enjoy teaching with the film. The pupils do

also. The film should only supplement and make richer the material which is taught. The way which was used in the experiment has used the film too often for the time allotted to the unit of topic. I am for the film in teaching science. I am not in favor of using the literature and procedure as outlined in the pamphlet. It is not adapted to Seventh Grade ability.

33. Our school utilizes visual aids as extensively as possible but I have never used any pictures as clear and well chosen as the ten Eastman films. The children have enjoyed them immensely also and have been encouraged by the clear conception of subjects treated to attempt individual expression and activities which they had not formerly felt competent of doing.
34. The presentation of the film was both pleasurable and profitable to me. Discussions of the pictures gave the children opportunities for original expression. Time was too limited to do extensive work.
35. We use, in our school, visual education to a great extent because we know that our children are handicapped by a language difficulty and I think both the children and I have gotten a wonderful knowledge out of the film shown.
36. It is more of a pleasure in teaching by this method. The pupils are more resourceful, and able to go ahead with their reports, etc.
37. I feel that the help has been most valuable to me, as this is my first year teaching a Geography class. My pupils are more interested in Geography than in any other subject. Four films on lumbering have been brought in by one pupil. So our film work is to be extended one more week. The children received this announcement with great enthusiasm. I believe the use of the films, daily, is a strain on the children's eyes, the only criticism I have to offer.
38. Yes, I have enjoyed this experiment very much. I considered each child a better educated child for having had this series of lessons. He has learned to get the information he wants not from one book but from many, that each has something to offer.

    He has learned to organize his material, and the value of organization. He has been presented with the fact that each process is organized in steps and if one step is omitted the process is not complete. He sees all these facts himself.

He also gets the appreciation of labor, and the amount expended and the effect of machinery.

To me this is just the type of training our children need. There has been something aroused in each child of my room. They just can't help learn something from the moving pictures presented.

I have not been entirely satisfied with results but feel this series of lessons has been time well spent.

A number of children has reported visiting points of interest related to subject taught. Also shown me old magazines found later — also told about things seen on trips. From comments I feel sure each child will gain more, see more and get more pleasure from his summer trip.

39. Much pleasure was derived from films both for teacher and pupils.
40. Yes.
41. Not as the film is used in this experiment. The film has been used as the *basis* of work and in my estimation should be supplementary to the problem at hand. In our work, I have divided my work into eight projects as we have eight five-week terms. Each term a project is launched. The project is reached from every angle, and is turned into a "daring" problem and credit is given for the application, and becoming a part of the pupil's daily tasks or routine of work. Pictures are shown only as a supplementary angle. In this experiment too much has been made of the one *smaller project* and the film. The pupils grow tired and the exams are too many. Since they know this is being done for outside people, lessens the interest. I think your films fine if used as supplementary work only and could have possibly twenty-five during the school year.
42. Yes, there is more pleasure in teaching except for the discussions after the film is shown. These drag considerably when the outline is followed. Otherwise the teaching is pleasant. There cannot be much originality developed when the material is organized, outlined, and given to the children in a finished form. The children do not get the experience of doing the organizing themselves.
43. Yes, indeed.
44. If the film was available when desired and could be used just as much as desired at a time it would be wonderful and can see great possibilities in its use.

45. It gave me great pleasure but much hard work for I knew so little about many of the wonderful things shown. I always felt the need of more time for my own preparation. Pictures always make a pleasurable lesson. Moving pictures give greater pleasure than still ones.
46. The "movie way" is inspiration to pupil and teacher. We all opened up our lesson with vital interest and closed it with, "Can't we stay longer?"
47. Yes.
48. Yes.
49. Yes, but we never seem to have enough time. The pupils just get deeply interested in a topic when we have to stop, and take up a new topic.
50. With more time given for each industry I would get *much* more pleasure out of the teaching using films such as these. However, I found it was very hard to get the children down to *real* work as they wanted to take it as they would a "movie show." They couldn't get the vision that there was much more to be found out — four or five days was enough and then hurry on for something more exciting. The last two films I got a little better results.
51.
52. As much as I enjoyed teaching with the films, I really think I would have found more satisfaction had the children been provided with reading material suited to their age.
53. The film experiment certainly gave me a great deal of pleasure in my work and showed me a new aspect of these industrial studies — a feeling that I was actually visiting these scenes myself.
54. Under normal conditions with greater flexibility of material to be covered, and of time in which to cover it, one should get more pleasure out of teaching and should be able to stimulate greater self-activity and originality in the children with the use of the films.
55. Yes.
56. Yes, it adds more pleasure to teaching.
57. This experiment has been the source of the most genuine pleasure and keenest enthusiasm of a long experience in teaching geography. Whether the scientific tests show its value or not, I am convinced that the film is an invaluable aid in stimulating self-activity, holding interest, creating originality

and fixing the underlying principles of geography as a study of man in relation to his environment. I am sorry the experiment is nearly over.

58. I love the film, but believe the scenario could be changed with a hundred per cent advantage to the child. The child is very willing to tell both before and after seeing the film just what he would like to see and learn.
59. Yes. The enthusiasm, research work, collecting items of interest and the apparent joyous pleasure of acquiring new knowledge on the part of pupils (and teacher) is the teacher's rich compensation.
60. Not as much pleasure because the work of explaining words in the guide makes it necessary to rush through the work and in most cases rush so rapidly that the work cannot be adequately covered. I do not think that film provides a greater stimulus but it certainly provides an equal stimulus.
61.
62. I cannot express how much I have enjoyed the work with the aid of the films. The activities carried on by the children outside of class which reflect their interest are many. Among them is the formation of a little club which is planting and raising many of the different plants we have learned about, i.e., wheat, corn, cotton. They tell me that they intend to make use of many of the things they have learned from the films, i.e., how to select seed, how to irrigate the crops properly, etc.
63. I think I enjoyed the films as much as the children did.
64. I certainly got more pleasure out of the teaching but the question of time for the recitation or the discussion period is so short that we have not had the opportunity to follow the latter part of the question to any satisfactory conclusion.
65. I do not care for the subject matter of the films as much as for our regular work. It excludes all nature study work, laboratory work, but if the topics were better related to the nature and needs of the child, I am sure that they would form a very valuable stimulus to the children.
66.
67. Yes, I enjoyed the films very much and they were very instructive. After using films I feel I will find it quite difficult to teach some of the subjects given in course of study without aid of pictures.

68. No doubt I would get more pleasure out of teaching with the film, but at all times, with each new film and guide, I felt a shortage of time for the amount of material to be studied and knowledge to be obtained which the film did not show. (Also think a few more titles were necessary in some films to make the meaning clearer. If I had more time for some of the films, I know I should have enjoyed teaching with the films, because they certainly are a great aid to the teacher and the pupil.) The use of the films helped to stimulate greater activity, and mental growth on the part of most of the pupils.

Some of the films the children enjoyed more than others. The one on "Compressed Air" they found very difficult. I, myself, felt it was too difficult and there was too much to learn in such a limited time. Most of it was beyond them, especially the girls' experience.

In regard to the type of tests used, especially in the first films, where many diagrams were required, I think you could have obtained a better measure of the knowledge obtained, both from the guide and film, classwork and reports, by using a different type of test. (Several other teachers feel the same as I do about this.)

69. Moving pictures are the coming features of modern education but it can never be used in any way but as an aid. Where there is action, there is interest and where there is interest there is always self-activity toward bigger and better understanding. The movie is the greatest modern contribution to education.

70. Yes. I have looked forward with pleasure to the period when I used the film because of the interest and enthusiasm of the children in the work.

71. Cannot say there was any pleasure in films and work required so far in advance of what children could do that most of work had to be done by teacher. I feel that we have been teaching film and not using films as an aid in teaching.

72. I worked with a slow group. Prior to the use of the film it was difficult to stimulate interest in the group in any subject. Later Geography became the choice subject of the class.

73. I have gotten a great deal of pleasure out of the teaching with aid of film but lack of time has lessened greatly the amount of interest I have been able to stimulate for greater self-activities.

74. Yes, even with my slow group. I have seen an improvement and with each picture a greater ability to comprehend the work.

75. I certainly have enjoyed teaching with the films for I can see far-reaching results which we are not going to be able to measure. I feel that I have been able to stimulate greater self-activity and originality in the children.
76. The film is a valuable asset to teaching. It is a clearing house for many difficult parts of explanation.
77. Yes. Most Science laboratories in Junior High Schools lack the equipment to get over ideas in a project way. The equipment is more suitable for secondary school work, so the films aid in bringing the general Science work down to Junior High School level.
78. It is a joy to have some method of explanation which does not call for chalk diagrams, always poor at best.
79. Yes.
80. Much more. Please send us more films, but give us more time.
81. I would like to use films in teaching.
82. I'm sure I would benefit greatly by use of film under normal conditions. During the experiment I've had to rush too madly and limit my lessons too much, covering points that might have been left out and leaving out some which were more important.
83. Yes. Students looked forward to pictures. Were disappointed if something happened to prevent showing of the film. Moving pictures, 15 minute reels, are a great help in teaching Science. I do believe better pictures can be obtained than some of those given us to show.

Outline for a Forty-five Minute Reading Period

Makes an excellent Program for teaching a Science period.

15 minute teaching of subject.
15 minute experimental work.
15 minute showing picture
and giving reports by students.

Of course adding variety all of the time for such a program is necessary, but such an outline as above will hold the interest, prevent friction of student and teacher, and really back student. Moreover, enabling them to pass better, thereby reducing number of failures. I heartily believe in Pictures as a great aid in all Education.

84. With it. All of these will undoubtedly increase when I can

spend more time on one film and use simpler films for the fifth grade.

85. Yes, but we feel that we could get much better results if we had more time for each film.

86. I should get much more pleasure with a group different from this one, better, though I can't say what results I might get. I have been greatly disappointed, not with the films, but with the lack of response from the group I have had. The students I have in the group are repeating General Science and every grade in the high school is represented in the class, though it is a regular eighth-grade subject. I do not believe it is the fault of the film or the study of these in the questionnaires sent out, but I rather think it is due to the inability of the students to grasp it, and their indifference to any kind of work they might have to do. One made the remark when the first test came out that he knew there was a trick in the whole thing.

87. Yes.

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